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American Machinist

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Volume 70 | New York, June 20, 1929 | Number 25

Relieving-Tools for Formed Milling Cutters

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

A simple geometric analysis of the distorted forms of relieving tools for cutters having straight line or circular forms and radial cutting flutes

EXCEPT for milling cutters with straight cutting flutes parallel to the axis, the form of the cutting edge of the tools used to relieve these cutters is distorted. Also the form of the relieving tool on a plane normal or perpendicular to its relief is distorted. Considerable mystery has been made in the past in regard to the nature of these distortions and the methods employed to compensate for them. Some of the methods of "back generating" these distorted forms are quite complex and involve the necessity of making a greater or lesser series of intermediate tools and templets in the process, and the results are not always as accurate as might be desired. This present article gives the results of a geometric study of this problem and shows how these various forms may be determined directly and readily compensated for in practice.

All points on the cutting edge of a helical-fluted relieved milling cutter must always be at a given relative radial distance from the axis of the cutter, this distance depending upon the form to be milled and the diameter of the cutter. In the case of a cutter that will mill a flat surface the cutting edges must always lie in a cylinder. The intersection of the relieved surfaces of such a cutter with a plane that contains the axis of the cutter, or the form of the cutting edge of a relieving tool which is to be set on the center line of the cutter will be a straight line, inclined from the trace of the cutting edges an amount depending upon the amount of relief and the lead of the helical flutes. This intersection must be a straight line because with a uniform helix of flute and a uniform radial relief, the radial distance to the relieved surfaces reduces uniformly at uniform angular distances from the cutting edges, and the angular distance between planes containing the axis of the cutter and different points of the cutting edge increases uniformly along the length of a cutter with uniform helical gashes.

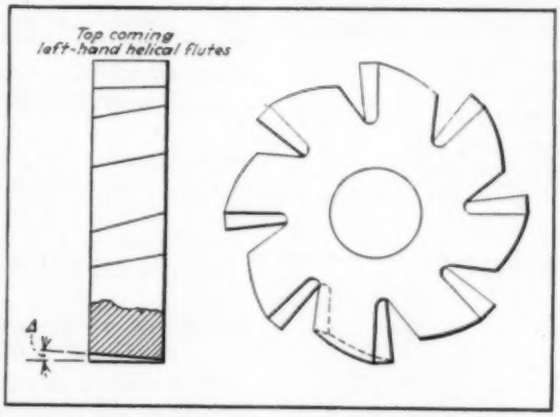


Fig. 1—The axial section of this left-hand, helical-fluted plain milling cutter shows the angle of distortion of the relieved surface of the flute

In order to relieve such a cutter, the straight cutting edge of the relieving tool must be set so that it remains in a plane containing the axis of the cutter, but the cutting edge of the relieving cutter must be inclined from the axis of the cutter an amount equal to the inclination of the intersection profile of the required relieved surfaces. This applies only to cutters having radial cutting flutes without undercut.

This distortion angle for such tools is determined as follows:

When L = lead of cutting flutes, in.
E = radial relief of cutter per flute, in.
N = number of cutting flutes in cutter
Δ = distortion angle.

$$\tan \Delta = \frac{N E}{L} \qquad (1)$$

The relief per flute is the theoretical distance the relieving tool would move radially during a turning movement of the cutter equal to the angular distance between two

The first part of the article. The second will appear in an early issue.

successive flutes. Thus with a single-lobed relieving cam, this relief is the rise in one complete revolution of this cam. If the relieving motion is set at an angle, as is often done in some cases, the equivalent radial relief must be calculated and used in the foregoing equation. Thus, if

δ = angle of relieving motion measured from a plane perpendicular to the axis of the milling cutter

E' = rise per revolution of single-lobed relieving cam.

Then $$E = E' \cos \delta \qquad (2)$$

If a double-lobed relieving cam is used, the relief per flute will be equal to half the rise of the cam per revolution, and so on.

The use of such distorted relieving tools with their cutting edges at the center line of the cutter is limited to relatively narrow faced cutters, or those with a slight helix, because of the possible interference of the edge of the relieving tool with the helical gashes. The wider these gashes, the wider the face of a cutter so relieved can be. To use this method on wider faced cutters, the form relieving tools must be made in relatively narrow sections and one part of the cutter be relieved at a time; or else the cutter itself may be made of several narrow sections.

The use of a wide relieving tool with its cutting face at an angle equal to the helix angle of the gash in the milling cutter requires a double movement of the relieving tool, one radial and the other tangential to the milling cutter, if the correct form of the relieved surfaces is to be maintained.

In Fig. 1 is illustrated the nature of this distortion by means of an axial section of a left-hand, helical-fluted plain milling cutter. This distortion angle would be in the opposite direction with right-hand helical flutes.

This method can be applied readily to the production of thread hobs with helical flutes. Here also, with a straight-line thread profile to be milled, the relieving tool will have straight-line profiles, and the distortion in angle can be readily calculated. For example, referring to Fig. 2, we would make the calculations as follows:

Δ = distortion angle (see equation 1)
α = angle of relief of relieving tool
γ = half included angle of thread
γ' = angle of relieving tool on high side
γ'' = angle of relieving tool on low side
Δ' = distortion angle normal to relieved surface of relieving tool

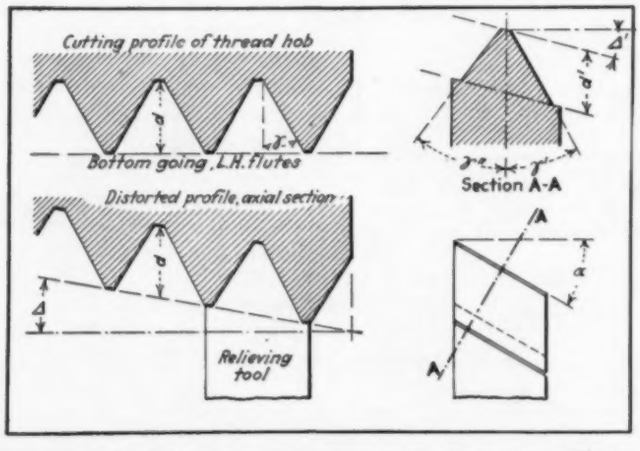


Fig. 2—Distorted profile of a thread hob with helical flutes and the corresponding angles of the relieving tool

d = depth of thread, in.
d' = depth of thread on relieving tool, in.

$$\tan \Delta' = \tan \Delta \cos \alpha \qquad (3)$$
$$\cot \gamma' = \cos \alpha \, (\cot \gamma + \tan \Delta) \qquad (4)$$
$$\cot \gamma'' = \cos \alpha \, (\cot \gamma - \tan \Delta) \qquad (5)$$
$$d' = d \cos \alpha \qquad (6)$$

As a definite example, we will take a cutter with annular grooves, such as a thread hob, with the following values:

$N = 16$
$E = 0.186$ in.
$L = 100$ in., L.H.
$\alpha = 25$ deg. $\quad \cos \alpha = 0.90631$
$\text{Tan}\, \gamma = 0.023/0.188 = 0.12234$
$\cot \gamma = 8.17391$
$\gamma = 6$ deg. 58 min. 30 sec.
$d = 0.094$ in.

From equation (1), we have

$$\tan \Delta = \frac{16 \times 0.186}{100} = 0.02976$$

$\Delta = 1$ deg. – 42 min. – 15 sec.

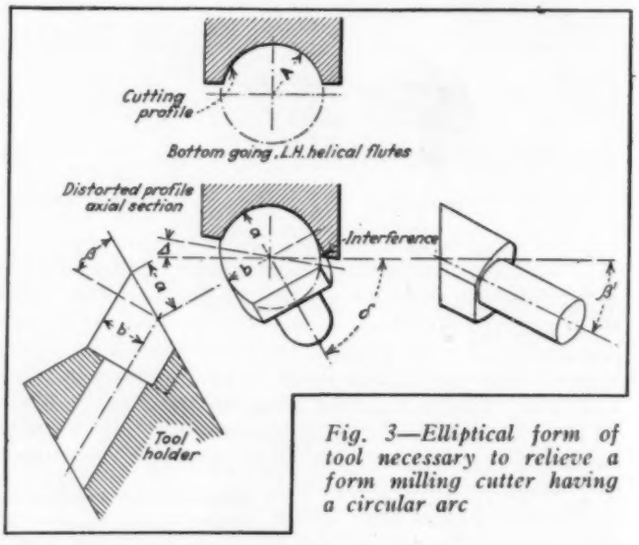


Fig. 3—Elliptical form of tool necessary to relieve a form milling cutter having a circular arc

From equation (3), we have

$\tan \Delta' = 0.02976 \times 0.90631 = 0.02697$
$\Delta' = 1$ deg. – 32 min. – 40 sec.

From equation (4), we have

$\cot \gamma' = 0.90631 (8.17391 + 0.02976) = 7.43507$
$\gamma' = 7$ deg. – 39 min. – 37 sec.

From equation (5), we have

$\cot \gamma'' = 0.90631 (8.17391 - 0.02976) = 7.34112$
$\gamma'' = 7$ deg. – 45 min. – 25 sec.

From equation (6), we have

$d' = 0.094 \times 0.90631 = 0.0852$

If a single-pointed tool is made to these dimensions to relieve the cutter, a suitable helical keyway must be provided on the shaft for the relieving cam so as to maintain the position of the relieving cam in proper relation to the helical cutting flute as the tool is moved from groove to groove.

The foregoing equations also apply to the relieving of a hob with a straight-line form in the axial section, such as on many spur and worm gear hobs. Here also the shaft for the relieving cam must be provided with a suitable helical keyway or its equivalent.

We will now consider the nature of the distortion on a circular form with tools of this type. Here the effect of the angular distortion is to change the form from

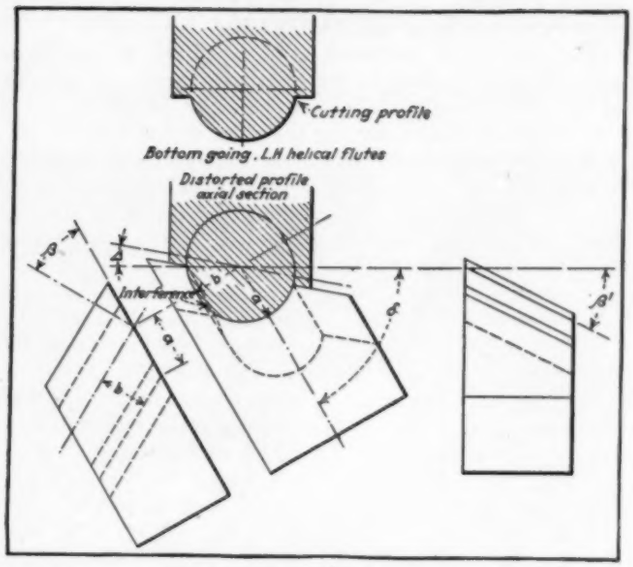


Fig. 4—A tool similar to that of Fig. 3, but inverted in form to relieve a convex form milling cutter

that of a true circle to that of an ellipse. Thus, when

A = radius of circular form, in.
a = length of elliptical form
b = width of elliptical form
δ = angle between 'a' axis and axis of milling cutter
Δ = distortion angle (see equation 1)

$$\text{Then} \quad a = \frac{A(\sqrt{\tan^2\Delta + 4} + \tan\Delta)}{2} \qquad (7)$$

$$b = \frac{A(\sqrt{\tan^2\Delta + 4} - \tan\Delta)}{2} \qquad (8)$$

$$\tan\delta = \tfrac{1}{2}(\sqrt{\tan^2\Delta + 4} + \tan\Delta) \qquad (9)$$

These conditions are shown in Fig. 3. At times the relieving tool may be made directly by grinding a cylindrical tool of radius b at an angle as shown. In this case when

b = radius of cylinder
β = angle at which tool is ground

$$\cos\beta = \frac{b}{a} \qquad (10)$$

If such a relieving tool is used, it should be provided with a flat ground surface as shown, parallel to one of the axes of the ellipse, so as to enable it to be set in the proper position. This position requires a double angular setting. A tool holder could be made as shown for such tools. This would have a hole bored at an angle equal to β. Then the tool holder would be set around to the angle δ. Such a tool can be used whenever its setting provides sufficient clearance for the relieving cut. One side of the tool shown in Fig. 3 will have interference as noted.

Referring to Fig. 3 we find that when

β' = projected angle of cylindrical tool

$$\tan\beta' = \tan\beta \sin\delta \qquad (11)$$

A similar tool can be made to relieve convex cutters. This design is shown in Fig. 4. The only difference is that a ground cylindrical hole is used instead of a plug to form the ellipse.

As a definite example we will consider the form milling cutter shown in Fig. 5. This is made in two halves with an interlocking section in the middle. As regards the circular part of the form we have the following values:

L = 39.091 in. lead
E = 0.250 in. radial relief per flute
N = 10 flutes
A = 0.6350 in. radius of circular form

Whence from equation (1) we obtain

$\tan\Delta$ = 0.06395
Δ = 3 deg. 39 min. 54 sec.

And from equation (7)

a = 0.65098 in.

And from equation (8)

b = 0.61502 in.

And from equation (9)

$\tan\delta$ = 1.03249
δ = 45 deg. 54 min. 57 sec.

And from equation (10)

$\cos\beta$ = 0.94474
δ = 19 deg. 8 min. 12 sec.

The angle at the edge of the cutter will correspond to γ' in Fig. 2, except that in this view it is not foreshortened by the relief angle. We will call this angle γ'_1. Then

$$\cot\gamma'_1 = \cot\gamma + \tan\Delta \qquad (12)$$

We will use a relief angle of 15 deg. on the relieving tools and make up a forming cutter as shown in Fig. 4

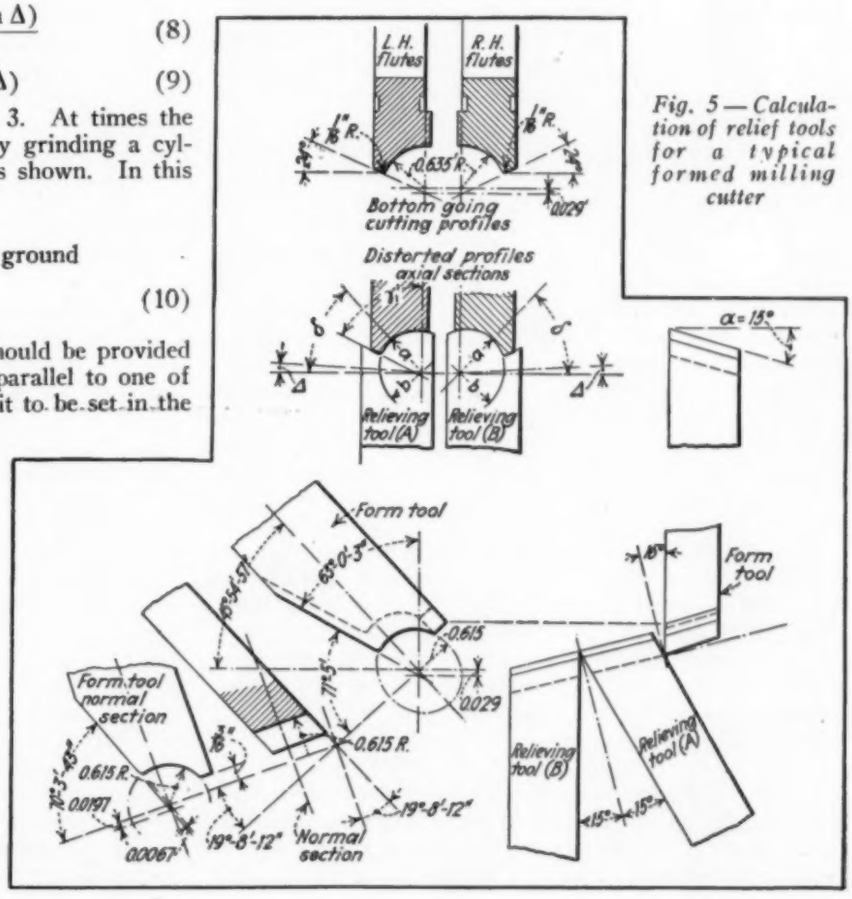


Fig. 5 — Calculation of relief tools for a typical formed milling cutter

to shape these relieving tools. In this way we can make a simple forming tool to cover the entire profile and can use the same forming tool to shape both relieving tools as the forms are similar, only reversed.

Whence we have $\alpha = 15$ deg.
and $\gamma = (90 - 24) = 66$ deg. $\cot \gamma = 0.44523$
and from equation (12)

$$\cot \gamma'_1 = 0.44523 + 0.06395 = 0.50918$$
$$\gamma'_1 = 63 \text{ deg. } 0 \text{ min. } 3 \text{ sec.}$$

This gives us an angle of 71 deg. 5 min. 0 sec. between the minor axis of the ellipse and this angular surface, as shown in Fig. 5. Multiplying the tangent of this angle by the cosine of β we obtain the tangent of the angle of this surface in the normal section of the forming tool.

Thus $2.91799 \times 0.94474 = 2.75674.$

Whence this angle in the normal section of the forming tool is equal to 70 deg. 3 min. 43 sec. as shown in Fig. 5. The position of this surface in relation to the center of the circle on the normal section is established by solving the various triangles involved. Whence its intersection with the center line of the circle is at a distance of $0.029 \sin \delta \cos \beta$ below the center of the circle, which equals 0.0197 in., and its normal distance from the center of the circle is equal to 0.0067 inch.

The radius of the fillet is determined in the same manner as the radius of the principle curve. The value of 0.0625 is used in equation (8) for A, which gives the radius of 0.0605 in. for the fillet in the normal section of the form tool. It will be noted that the position of the axis of the cylinders used to form the ellipses depends only upon the distortion angle so that all circular forms on the same cutting profile will have parallel axes on the forming tool.

A hardened and ground form tool with its normal section as shown in Fig. 5 can be made directly with little difficulty. This form tool can then be used to shape the two relieving tools as shown at the left. The relief on these relieving tools must be taken as somewhat less than the angle β so as to provide cutting clearance. By tipping the form tool away from the normal section of the relieving tools the same angle as the relief on these relieving tools, the shape of the normal section of these relieving tools is automatically corrected for the foreshortening of the form due to the relief. This example should be sufficient to indicate the many possible applications of this method.

Employer Is Liable When Workers Quarrel

By Leslie Childs

THE question of an employee's disposition and temperament may seem of little or no concern to an employer, as long as the employee is competent and faithful in the discharge of his duties. However, in view of the wide application of workmen's compensation statutes (only five states are without such statutes at this time) this is not altogether true. This for the reason that under such statutes an employer may be saddled with liability, running into thousands of dollars, for injuries growing out of personal conflicts between employees, provided the trouble arose out of and in the course of the employment.

In one case of this kind, a Michigan manufacturing company had in its employ one Little and one Dombaski. Little was employed to operate a drop hammer, and it was Dombaski's duty to deliver material to the place where Little was working. In this situation, a foreman, who was over both of the men, instructed Little to see that Dombaski placed the material properly. Pursuant to these instructions, Little told Dombaski how the material should be placed on the shop floor, and the latter took offense and retorted in an angry manner. Little paid no attention to this and a few minutes later, without further warning, Dombaski struck and seriously injured Little with an iron bar.

Little applied for and was awarded compensation for the injury so received by the proper state board. His employer appealed from this award, taking the position that the injury was not connected with the employment, but was caused solely by a personal quarrel between the two men. The case reached the higher court on appeal, and here in holding the employer liable, on the ground that the injury arose out of the employment, the court said:

"There had been no previous quarrel nor other trouble between the men. Dombaski was quick-tempered and quarrelsome. Apparently the sole reason for the assault was his resentment because of the directions which Little gave, and which it was his duty to give. It grew out of the work which plaintiff [Little] was required to do in the course of his employment."

As a further illustration of how the courts look upon situations of this kind, a brief review of another case of this character may prove of interest. In this case an industrial company had two employees, Trott and Beam, who were engaged in driving dump cars in hauling materials. It was a part of Beam's duty to direct Trott where to haul from and deliver.

They had a disagreement about the division of the work, but Trott did not take this seriously and continued until the shift was over. Following this, when Trott was changing his clothes, preparing to go home, Beam entered the room and drawing a revolver shot Trott several times, injuring him seriously. This occurred while the men were still upon the employer's premises.

For the injury suffered Trott brought an action against the employer for compensation, under a workmen's compensation statute, claiming that his injury arose in the course of his employment. The employer denied liability, but Trott was awarded $4,000. On appeal, the court in affirming this award reasoned as follows:

"We think the evidence shows clearly that the injury in question arose out of Trott's employment. It was the direct and final result of the quarrel that the two employees had over the question of whether or not Beam was treating Trott fairly in designating the hauls or trips that Trott should make for him. The whole evidence tends to show that Beam was still harboring malice against Trott that was engendered by reason of the quarrel over the question of the division of the work."

The foregoing cases illustrate what may be termed the general rule of construction in situations of this kind: This rule is that an assault by one employee upon another that is incident to the duties of the employment arises out of the employment and renders the employer liable for the injury caused.

Chromium Plating Radiator Shells

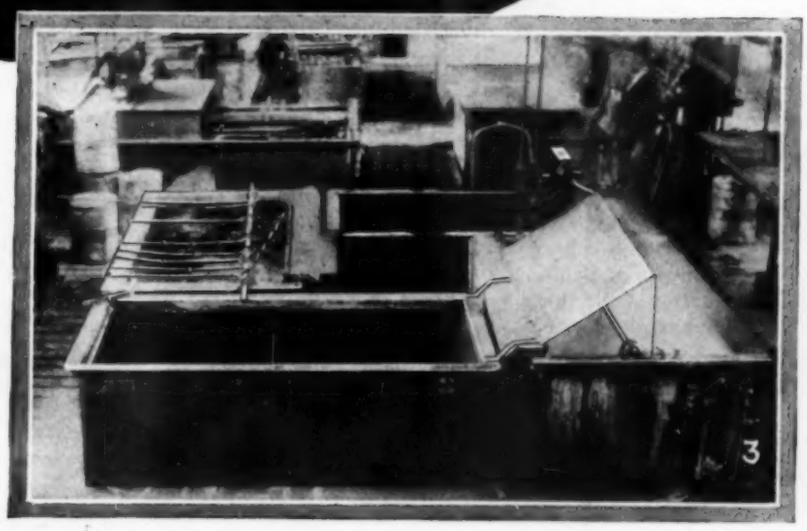
Photographs by courtesy of the Chrysler Motor Car Company and the Hanson-Van Winkle-Munning Company

IN THE finishing of 800 radiator shells a day at the Chrysler Motor Car Company plant the polishing and buffing are done on one side of the room and the plating on the other. Three lines of continuous overhead conveyors, as seen in Fig. 1, pass above the polishing stands, one of which also goes alongside the plating tanks. After the first polishing the shells are not permitted to touch the floor again, but are hung on the conveyors after each operation.

After polishing they are carried to the tanks where they are taken off for copper plating, remaining in the automatic tanks for 15 min. They are then carried by the conveyor back to the polishing stands where they are given a buff on a linen wheel and put back on the same conveyor line to return to the tanks. The next operation consists in nickel plating for 30 min. in the automatic tanks shown in Fig. 2, and nickel buffing on a linen wheel. A high luster is required before the chromium plate is applied.

The Bureau of Standards' chromic acid solution, with slight modification, is used for the chromium plating. The final operation is simply "coloring" the chromium plate on a soft wheel.

The plating tanks are in groups, as are also the rinsing and hot washing tanks, Fig. 3. The conveyor on the plating section of the room passes along one side within easy access of all tanks. Shells on which the polishing operations have not been completed can be passed around the polishing room on the double line of continuous conveyor without passing through the plating room. Finished shells are unloaded for packing at one end of the conveyor.



Interesting Men in the Job

"MEN don't take an interest in their work any more," wailed John Farley, of the old Reaper shop at lunch at the Business Club. "All they seem to think of nowadays is quitting time and payday."

"What's the matter now, Mr. Farley?" asked young Dick Brinton who was running a fairly successful small business doing contract work."

"Matter," growled Farley. "Didn't I tell you they don't care whether we get the work out or not, or how long it takes, or anything about the machines."

"And what do you do to make them take an interest, John?" Spoke up Harry Leonard. "Do you tell them anything about the business? Do even your foremen know much about where your stuff goes, or about the cost of material or machines?"

"Don't I hire them and pay them good wages, Harry? Why should they know about materials and costs? That's my business, isn't it?"

"Of course, John, if you want to keep it so. But you can't expect men to get very enthusiastic over a business they know nothing about. I wouldn't expect my men to care about our shop if I didn't keep them posted as to how things are going."

"Going to tell them how much money you make this year, I suppose," retorted Farley?

"No special reason why I shouldn't, John. They can find it out anyhow from the annual report. And since I've got over the shock of telling the income tax collector about finances every year, the rest don't worry me any.

"In reality, men don't care so much how much you make as long as you make something. They feel a lot safer with a firm that's making money. Just how much doesn't bother them as long as you pay the going wage and play the game squarely with them. And the more interest you show in them, the more they'll show in you.

"How does that strike you, Bill? Ever find any good shops that coddle men like that?" asked Farley of Bill Holland.

"I wouldn't call it coddling, John. And I've seen a lot of successful shops that make it a point to interest the men in the job. Tell them how you handle it in your shop, Leonard."

"Easy enough, Holland. In the first place, I always say 'we' and 'our' instead of 'my' and 'mine.' I think I beat Lindbergh on that score.

"When we have an interesting job I call in the foremen and tell them all about it. I tell them about any new material to be used, about where the machine goes and what it does. If it is a closely competitive job, I tell them and show them what we've got to do to make a profit. They pass the word down the line, the men get busy and we generally pull out in good shape. I suppose you run across similar cases in your rambling about, Holland?"

"Yes, Harry, I find more and more managers who do something of the sort and find it pays. Some use bulletin boards and give a lot of dope on jobs and other things in that way. But there's something to be said for the word-of-mouth method. The disadvantage is that it's so easy to get things twisted in the telling."

"I use bulletins, too, Holland, especially to keep the men posted on how the job is progressing. If we're behind schedule, or ahead, I tell them. If a job turns out specially well, like those pumps I built for New Zealand, I tell them all about it. And they get a real kick out of it, too, just as I do."

"But don't they keep pestering you for more money when they know you make a nice profit?" queried Farley.

"I pay good wages, Farley. I get the pick of men, and it pays."

"That's foolish sentiment," growled Farley.

"If you had your men working *with* you as mine do with me, you would think sentiment is worth while," retorted Leonard.

"There seems to be nothing like interest in the job to cut costs and smooth out difficulties," said Holland. "It isn't always an easy job, John, but Leonard seems to have found out how to do it and that it pays in the long run."

EXECUTIVE FORUM

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Discussion

Can Shop Losses Be Charged to Sales?

Obviously, shop losses cannot be classed as sales expenses, as a general proposition. On the other hand, while this is a brand-new slant on the subject of unproductive, special, or semi-occasional good-will orders, I have been on the productive end of the shop arguments for so long that I would like to see some such proposition put across.

While shop efficiency, economy and strict control are constantly necessary, too much stress has been laid upon the production economies, with the natural result that wasteful methods in such departments as office, sales and advertising have been largely overlooked. In any organization there are usually several men whose duties involve investigation and improvement in labor and material costs, but sales and office inefficiencies have come to be classed as "necessary evils." The big thing for a man in Jones' position is to make his proposition "stick," but if this sort of thing could be carried out to its logical conclusion, it would be wholesome for a lot of industries.

—D. C. WRIGHT.

Is the Shop the "Goat"?

The usual practice today is to look to the direct labor cost whenever it is necessary to cut prices, but if all costs are carefully analyzed it will be found that in nearly every case the direct labor charge is least of all. Any saving in this cost reduces the overhead by only a very small fraction of that saving, and, if it is resorted to, the more valuable hands, who really carry the overhead burden, will leave.

If the usual practice is reversed, and overhead is first attacked, operators will understand the necessity to cut costs, and will be more ready to back up the effort. They may even be willing to agree to piecework price-cutting.

A better way of effecting a saving in the shop than cutting prices is to encourage operators to express their opinions as to where savings can be made. A suggestion box system, correctly handled, is of great assistance. I have discovered that many valuable points are brought forward by operators, and above all, a feeling of co-operation is established.

—R. L. TANDY, *England.*

Price or Service?

A few years ago our manager bought, on my suggestion, an American vertical turret lathe, built in a well-known factory. The price was high, and a friend of our manager declared that it would be quite impossible to amortize the investment in a reasonable time. Two years later we needed another vertical turret lathe and my proposal was to buy it from the same factory. I was fully justified in this because our American machine had shown that, in spite of its high price, a reasonable amortization was possible without difficulty.

But, instead, I was furnished with a much cheaper turret-lathe. The machine tool ran all right for six months, and then our troubles began. Innumerable weak points developed, and the ultimate cost of the buying-on-price policy was much greater than the investment would have been in the more expensive machine. Service, satisfaction and results are the factors that count. The first turret-lathe cost four times as much as the cheap one, but the next turret lathe we buy will be in a class with the first.

—FRANZ BERMANN, *Supt., Locomotive Factory. Priv. öster.-ung. St. E. G., Vienna.*

Purchases should be made solely on the basis of total cost. Investment costs and probable operating and maintenance costs are all a part of the calculation. Some of these expenses are a matter of existing book records, but others must be estimated. In the case of a machine, the maker's reputation for turning out a well-constructed and durable product is an important element.

The question of service after delivery is open to debate. A complication is introduced if a machine is used for purposes other than those for which it was designed. The product of a competent and reliable maker should not need the bolstering influence of free service, if rightly used. The manufacturer should have enough confidence in his machine to sell it for a price based on its merits, and make a reasonable charge for all service.

Whenever free service is given on a machine, someone has to pay for it, and as a result every buyer is called upon to make a large investment in the first price, regardless of whether or not he ever calls upon the manufacturer for service. In this way, many companies pay for something they never receive. After all, most of the demands on the service agency of a machinery manufacturer should be not for repairs, but to obtain help in broadening the scope and usefulness of the product.

—L. O. BROWN, *Toolroom Foreman, Holcomb & Hoke Manufacturing Company.*

Design Elements in Feed Screws

By Tom Addison
Engineer, Cincinnati Grinders Incorporated

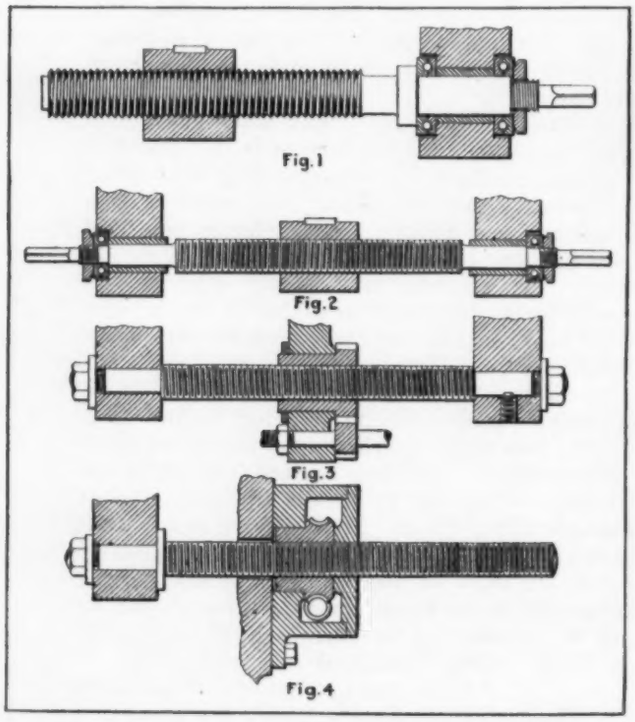
THE usual method of transmitting motion to sliding parts such as carriages, cross-rails, and work-heads, is by applying turning effort at one end of a screw. If the screw can be adjusted manually it is the practice to cut a thread that will move the sliding part away from the operator when the screw is turned in a clockwise direction. This usually means a left-hand thread, as for example on a boring mill or planer cross-rail.

Various methods of mounting the screw can be used, and the one in general use is shown in Fig. 1. In this case end thrusts are resisted in both directions by a single bearing. Moving the head by rotating the screw in a clockwise direction produces a bending action due to compression of the screw. The greater the resistance to rotation and the further the nut on the head is away from the point of application, the greater the combined twisting and bending of the screw becomes. The sagging of the free end of the screw produces an excessive wear on the nut and on the screw in general. This method of mounting demands a very large diameter screw to resist all the movements produced.

Mounting the screw as in Fig. 2, converts compression into tension, and bending into straightening, the end thrust being transferred alternately from one end to the other, depending upon the direction of rotation. Here an extra bearing has been provided and hence the sagging of the screw has been decreased. The diameter of the screw can also be made smaller than in Fig. 1 due to the fact that bending is largely eliminated. Nevertheless, torsion is present just the same as it is in Fig. 1 and to decrease this the mounting as shown in Fig. 3 is used.

The application of this is shown on the open side planer in Fig. 5, where we have a screw held rigidly at both ends and also held from rotation. This construction requires the nut to be the rotating element driven by gearing that slides on a secondary splined shaft. Bending and sagging of this screw is practically eliminated, torsion is decreased, an extra bearing is provided and greater accuracy is thus obtained. One planer manufacturer uses this method throughout for moving all heads, tool holder slides, and also elevates and lowers the cross-rail by this method.

Another machine of the jig-boring type reverses the arrangement previously described, and uses the one shown in Fig. 4. Here, the nut in the form of a worm wheel, is rotated as before, but is held from moving endwise. Again the screw is held from rotation, hence in this case the part that is attached to the screw moves, in this particular case, it being the cross-rail.



Figs. 1 to 4—Different methods of transmitting motion by threaded shafts

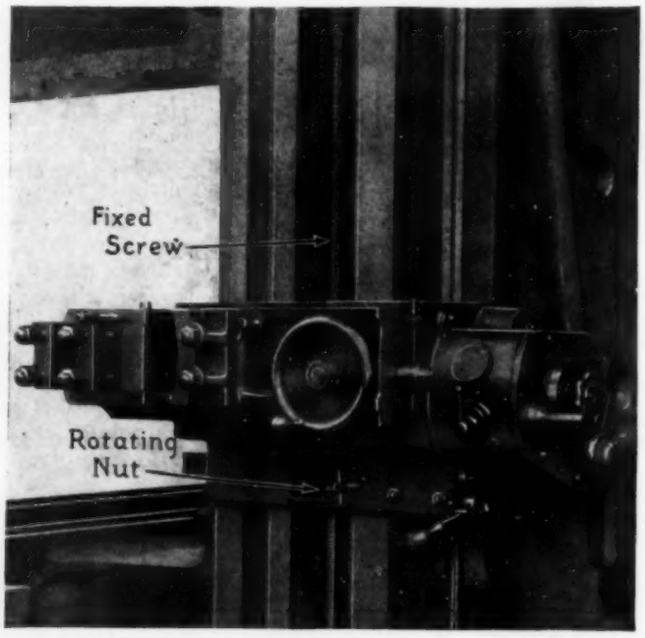


Fig. 5—Application of fixed screw and rotating nut to an open-side planer

The use of splined shafts should be discouraged. Albert Clegg, in his article, "Some Debatable Elements of Lathe Design," in a European edition of the *American Machinist*, makes the following statement: "Some firms, mostly American, it might be noted, began years ago to build lathes with a splined feed screw, and most of them continue doing this to the present time. So far as the writer is aware not a single British maker uses the idea."

Extreme care must be taken in breaking the edges of each thread at the spline, to prevent reamer action and hence excessive wear of the mating nuts. Furthermore, when splined screws are used they act detrimentally in two ways, the first being decreased strength and possible bowing of the screw; and secondly, they act as a channel for the lubricant, allowing it to escape. Proper lubrication of both screw and nut is too often overlooked by designers, with, of course, a few notable exceptions.

Executive Considerations in Tool Design and Production

By M. H. Flynn

Factory Manager, Allen Manufacturing Company

Production control is a necessary basis for good tool planning, and standardization of methods, parts, and equipment will make production more simple

REAL economic planning of the tool equipment cannot be done without an understanding of the production requirements. In every manufacturing plant there is a system of some kind by means of which the work is scheduled for the men and machines and followed as it goes through the plant to make sure that it is completed. In some plants there may be no formulated system, and the work may be done by the superintendent or foreman, who have their working forces so well organized that very little supervision is needed to start new lots of work and to keep the work going till it reaches the shipping room. Such a man may say that there is no production system in his plant. Yet, although he may not have thought of it in those terms, he has, if his work moves smoothly, a very definite one even though it is not on paper.

In other plants production departments are maintained in which large, highly organized forces of men and women are employed scheduling and directing production. If not carefully watched by the management these production departments become over systematized and costly and an excessive burden on the business, when compared with the results obtained. Since this work is always a burden on the business, moreover, the most simple system that can be devised to produce results for any particular job is usually the best one to be employed.

Each man who has to plan and maintain production will have a method of his own. Many good systems have been devised and put into efficient operation. Some are planned to maintain at all times a very small shortage, or to make just enough of the parts needed, and others to have a surplus. Low inventories and low manufacturing costs follow the use of the shortage system. The danger is that a shortage of some part may suddenly become too great for safety. Excessively large inventories are often found in plants run on the surplus plan, but a surplus of finished products must be carried by companies who advertise to ship their goods from stock. It is not always possible to foresee the customer's demands.

Some production systems are operated in conjunction with cost and wage payment systems and the employees are kept informed of the daily or hourly results by means of bulletins or progress charts. In a plant large enough to employ tool designers and toolmakers, the manufacturing work may be extensive enough to require an organized production department. In a new company, preparing to manufacture a product requiring tool designing, a production system, planned and put in operation as soon as the work of preparing for production begins, will allow model, drafting, tool, testing and manufacturing work to be performed according to schedule.

In setting up a production system certain principles should be observed:

1. The department should be as small as possible, because it is all overhead expense.
2. There should be one head with power to enforce orders.
3. Everything that is to be done should be listed, and a schedule should be established to include purchasing, tool designing, and toolmaking as well as production.
4. The schedule should be maintained against all obstacles.

Production schedules are based upon the part list and contain lists of everything to be done in preparing for and maintaining production. This looks like excessive work when a machine compris-

Fig. 24—A production department in a large office-machinery plant. The swinging frames contains graphic representations of the progress of parts through successive operations throughout the factory. All of the routing, transferring, and crediting of parts is controlled here and the department is considered as a separate unit from the shop and office

The fourth article in the series. The fifth and last will appear in an early issue.

ing thousands of parts is to be built, but the work may be done in a simple way if the machine has been listed correctly and the mechanisms separated into groups. With a knowledge of the men and equipment available, it becomes possible to schedule all of the tool designing and building and the production of the parts, and to have the work done according to schedule.

If the existing methods for controlling production cannot be extended to include tool designing and toolmaking, the men in charge of these departments will find their work progressing in a much more orderly way if they will write a list of all the work to be done in the department, add new jobs as they come in, and check off jobs as they are finished.

This is done in some drafting and toolmaking departments, but in many places no record of incoming or outgoing work is kept, except for cost purposes, with the result that the foremen never know exactly how much work is ahead of them. As a result their men are taken from an unfinished job to rush one that has been overlooked, or frequently the men cannot be kept busy with consequent loss of production. If the incoming work is all listed, it may be scheduled to the right men and more work accomplished.

If the tool work is to be done rapidly and accurately to a schedule, the designer must have complete and accurate information concerning the part to be produced. This should be supplied in the form of detailed drawings of the parts. Models are not sufficient.

These drawings are best when made uniform in size and type for filing, each sheet showing only a complete drawing of the part with all dimensions, including manufacturing allowances and tolerances. If these drawings are carefully checked, most errors will be eliminated, but the best way to make sure that all errors have been found is to make models of the parts to the dimensions on the drawings and test these parts by assembling them together into a complete mechanism. In addition to uncovering errors this also gives a working check on manufacturing allowances. The working part drawings of small, fine mechanisms are sometimes checked by making large-scale drawings of the assembled parts, but this is not as good a way as the working-model test.

The tool designer's work begins when he is given a part drawing or a model of the part to be reproduced. If this part is one of many parts in a mechanism, the tool designer will study all of the parts together so that the set of tools will be uniform in design and will provide for the manufacturing allowances and tolerances required.

The method of manufacture must be selected first. This is controlled largely by the machine tools available, but often the tool designer has to select the machine tool as well as the type of tool. For new work the most simple operations that can be done on standard machine tools are best. This plan will give good production at reasonable cost and will allow for development at a later date when production requirements are better known. When new tools must be used for old operations, simple tools and standard machines are better than special automatic machines, unless a great cost reduction or large production can be made with the special equipment.

After a study of the possible methods of machining has been made and the machines and tools for the work have been selected, an operation list for the part should be written. This list must include all of the operations, steps, or handlings through which the part must pass from the raw material until it is placed in storage, ready for assembly or sale. An operation list of this kind takes, for example, a casting as it is received on receiv-

Fig. 25—This "Requirement Analysis" is used in computing the daily requirements of parts by an analysis of the employment of the part on various machines or equipment manufactured by the plant. The tool designer needs this information to plan for tool requirements

R. T. CO. Inc., Form F 180 — 9 17-26 3 M

OPERATION SEQUENCE & ANALYSIS

PART NO._____ NAME_____

DEP'T NO.	OPERATION NO.	OPERATION NAME	Minimum Time Allowed Between Operations	Total Stock Days Allowed	Standard Prod. Per. Hour	REMARKS

Fig. 26

R. T CO., Inc. Form F-146 — 9-20-28

REQUIREMENT ANALYSIS

PART NO. AND NAME_____

		10"	12"	14"		18"	20"	26"		DAILY REQ. All	10P	12P
84 Character	ALL											
	10P											
	12P											
88 Character	ALL											
	10P											
	12P											
92 Character	ALL											
	10P											
	12P											
Q Model	ALL											
	10P											
	12P											
Portable	ALL											
	10P											
	12P											
	ALL											
	10P											
	12P											

THIS PART IS ALSO USED FOR

PART	AFTER	OPER.
"	"	"
"	"	"

Remarks

WEEKLY PRODUCTION SCHEDULE

Model 10

Portable

YEAR	PART ORDERS	SCRAP

THIS PART TO BE ORDERED IN_____LOTS

PROD. CONSTANT

TOTALS

P. O. AND SCRAP ALLOWANCE

TOTAL PART DAILY REQT.

" OI " "

Fig. 25

Fig. 26—"Operation Sequence and Analysis" is a form used to give the assignment of time required for various operations. It is the official tie-up between equipment requirements and production, and gives the tool designer the data for the quantity, type, and placement of equipment needed for the work

Fig. 27—An automatic heat-treating machine brought out by the tool designer to overcome a production problem

Difficulty was experienced in the assembly and in the unequal wear in service of the type bars of a certain typewriter. The production department traced this to the unequal heat-treatment, so the tool designer designed this machine to take two complete sets of bars at a time at one station, dip them in the acid, then in the lead pot, and finally at the fourth station to drop them automatically into the oil quench at the left. Not only were uniform bars obtained, but also production was increased and hand labor eliminated

ing platform and shows trucking, polishing, plating, or painting, and all the inspection, gaging, transportation and other operations that must be performed to place this casting in stock packed for shipment. It is one, therefore, to be studied with much care before tools are made. With careful study of this list, handling costs and often machining costs may be reduced to a minimum. If the list is not written, attention will not be directed to those operations that increase overhead expense, with the possibility that they will be multiplied, thus hampering the project before it can get fairly started.

There are many operations in manufacturing that are often overlooked by the tool designers and by those who make cost estimates. Snagging, burring, filing, and hand fitting are very often not put on operation lists because tools need not be designed for them. These small operations sometimes amount to large sums that cut into the expected profits. They would receive more consideration if put on the operation lists. Frequently, if the tool designer's attention is called to them by having them on the list, he can eliminate them by providing a different type of tool. This loss can be illustrated by screw machine tools. Many expensive circular form tools are designed and made that leave a burr on the work that has to be removed in another operation, which burr can be eliminated by a slight change in design of the form tool.

If a tool designer merely designs the best tools that he can, to be used in machines that he knows are available, he may have successive operations placed in machines that are far apart, when a study of an operation list by himself or the production man who is in charge of the machines, might save much transportation by having different kinds of tools made for machines that are near together. In fact, the producer, who is usually the department foreman, should be consulted both before and after the operation list is written, and also while the tools are being designed.

A tool list for each operation is as necessary as an operation list. This list also must be complete and contain all the machines, apparatus, tools, and appliances needed to do the work. This completeness is more necessary in new work than in making tools for old operations, because, if completely made, a tool list for a new project may be used as a purchasing list for work benches, vises, stools, arbors, standard cutters, drills, reamers, taps, and other standard equipment. If listed before tools are designed these standard articles may be procured while tool building progresses, so that operations may start when the tool is built. Costly delays have resulted because a special drill, reamer, or other small tool was not ordered until the operation was to be started.

The operation and tool list, if carefully revised after the study is complete, may well be made a permanent record. It is useful in purchasing, in directing and changing operations during the production period, and as a reference when changes in design of the product are to be put into production.

In selecting or listing small tools for manufacturing operations, standard tools should always be specified. Some engineers and tool designers specify small tools and other articles that must be made especially to their designs. This is wasteful, causes delays, and is as costly as it is unnecessary. It is possible in most cases to use standard tools instead of the special tools asked for, but some engineers refuse to change their designs and specifications and force their employers to pay for the special equipment. In addition to the extra expense to the user, these special tools are the cause of much annoyance to the companies that make them, if they are purchased outside. They must be made on special orders and cannot be run in regular production. In fact, the high prices that are often charged for specials do not cover their cost.

The worst feature about the use of special small tools, is that, because they are special they cannot be purchased quickly if, through an oversight or a sudden increase in demand, the stock is depleted. The manufacturer of the special article may have a full schedule of specials in production for others and be unable to produce the required tool for a long time. Sometimes the user has to

suspend operations or make the special tools himself, if he can.

All of the work of standardization and the publicity that has been given to the efforts to eliminate waste in industry seems to have had very little effect upon some engineers responsible for it. They continue to insist upon being provided with tools that are just a little off standard, when a slight change in design would allow the use of a standard article.

Any company that is purchasing special equipment such as off-size drills, taps, reamers, wrenches, and screws for use in its product or in the manufacture of the product can usually save much money, avoid costly delays, and increase production by changing the design of the product slightly so as to use standard goods. The cost of making the study and of changing the tools and the product would in many cases be covered in a short time by the savings that would result.

Influence of the Automotive Industry on Engineering Education

By A. P. Gwiazdowski
Assistant Professor, Department of Engineering, University of Michigan

THE University of Michigan is located in the midst of the automotive industry. Probably 80 per cent of the automobiles are manufactured within a 75-mile radius of Ann Arbor, the seat of the university.

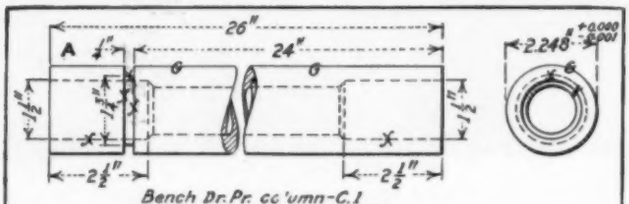
The director of the university shops has realized the tremendous economic importance of tools, jigs and fixtures in modern production methods for interchangeable parts. It is also realized that the manual training method of teaching shop practice will not suffice for the engineering student, and we are developing a new and interesting system to take its place.

Exercises in shop and production problems are used as an introduction to the shop practice course. After this preliminary period is over the student is given problems in tooling up for specific jobs.

The specific part shown in the illustration is the column of a bench type drill press. The necessary tools must be laid out for this, and the machining times established.

In the present case a drill jig, for enlarging the 1¼-in. cored holes in each end, is necessary, and also "V" angle fixtures to hold the column while being drilled. Both the drill jig and the fixture were made up of scrap parts from various sources. It is felt that this method teaches economy of material as well as presenting difficulties not encountered with new material.

The simplicity of the set up, the accuracy and rapidity with which the job is completed are impressed upon the student, and he recognizes the necessity and importance of the various devices used in mass production. In the meantime he is acquiring skill in the use of tools, which is the manual training ideal, but in his case it serves only as a stepping stone to more important things: design, production, and management.



Bench Dr. Pr. column-C.1
1 required, patt. No. B.D.P.-3
leave 0.010 for gr.

OPERATION INSTRUCTION SHEET SPECIAL JOB NO.1

Drill, turn, and grind cast-iron column 264-3 for drill press, bench type

Operation No.1
Machine tool, tools, and accessories:
a) *Radial drill press No.85*
b) *Drill fixture No. 264-F-3*
c) *Drill jig No. 264-J-3*
d) *1½ inch Three-lip high-speed steel twist drill*
Machining: *Drill both ends 2½ inches deep*
Speed 300 R.p.m. Hand feed

Operation No.2
Machine tool, tools, and accessories:
a) *Center inserts No. 264-T-3*
b) *Greenerd arbor press No. 161*
Operation: *Press in center inserts at both ends*

Operation No.3
Machine tool, tools, and accessories:
a) *Lathe to be assigned by instrutor in charge.*
b) *Face plate, dead and live centers, outside calipers, 3-inch micrometer, 6-inch scale, dog, tool post wrench, turning tool, cut-off tool, and cutmeter*
Machining: 1) *Set calipers to 2 11/32 inches and rough column to that size.*
Speed 60 feet per mimute Feed 0.014 per revolution
Check the speed with cutmeter
2) *Measure both ends with micrometer. If sizes differ, adjust centers and take light cut at both ends. Measure again, etc.*
3) *Finish turn to specified size.*
Speed 85 feet per minute Feed 0.014 per revolution
4) *Turn ¼ inch slot with cut-off tool. Use calipers and scale only*

Operation No.4
Machine tool, tools, and accessories:
a) *Cincinnati cylindrical grinder No.118*
b) *3-inch micrometer*
c) *Dog*
Machining: *Grind to final size*
Grinding wheel surface speed 6000 feet per minute
Work rotating speed, 100 R.p.m.; table travel, 26 in. per minute, Depth of cut, 0.002 for rough, and 0.001 for finish.

Operation No.5
a) *Cut off end A on Armstrong-Bluhm hacksaw.*
b) *Grind end A on disc grinder No.108*

Operation instruction sheet used in tool design course at the University of Michigan

What is a Slot—*Discussion*

By Wm. C. Brubaker
Dean, The Pullman Free School of Manual Training

REFERRING to the discussion on page 518, Vol. 70, of the *American Machinist* as to a name for grooves cut in the cylindrical surface of a solid body, it appears to me that the word "peripheral" should designate such slots or grooves, and make the distinction clear between such grooves and the annular groove which E. R. Plaisted considers may be cut only in the end of the cylindrical body. I would suggest the term "peripheral groove" to meet the requirements he indicates.

Accidents can be prevented by forbidding workmen to carry any appreciable weight up a ladder. It is much safer to have the tools or parts to be used raised by a crane or hoist because it is very easy to lose one's balance when climbing with a heavy weight. Then too, there is the danger of dropping tools on those below, as well as the fatigue that is usually unnecessary. Frequently rungs break under the double load, causing serious injuries.

· BOOK · REVIEWS ·

ARC WELDING. Lincoln Prize Papers submitted to the American Society of Mechanical Engineers. Edited by Edward Pierce Hulse. Four hundred twenty-one pages, 6x9 in. Published by McGraw-Hill Book Company, Inc., New York City. Price $5.

FROM the 77 papers submitted in the Lincoln arc-welding contest, the three prize papers, the two that received honorable mention, and two other outstanding papers have been selected for publication in the book "Arc Welding." These papers include rather complete discussions of the fundamentals and economics of arc welding, and are illustrated in detail by examples from ship construction, rails, pipe lines, and cells for inclosing truck-type switch gears. They contain much of practical value to design and production executives, and to everyone who is interested in learning about the present status of welding. Considerable emphasis is laid on the fundamentals of design and shop practice necessary to insure widespread economic use of the arc-welding process. The papers form a valuable addition to the shop and office welding library.

MEN, MONEY, AND MOTOR. By Theodore F. MacManus and Norman Beasley. Two hundred eighty-four pages, 5¼x8½ in. Published by Harper & Brothers, New York. Price $3.

WHETHER the claim that this volume is the first inside story of the automobile industry can be substantiated or not, it is an interesting book and one that holds the attention from start to finish. Naturally the names of Ford, Couzens, Leland, Durant, Olds, Packard, Winton, Dodge and other pioneers figure largely in the narrative, while Flanders, Franklin, Chrysler, Nash, Willys, Buick and many others also play an important part. A large part of the book is given to conversations between the well-known men, so much in fact, that one cannot but wonder just how authentic they may be. They do, however, show very clearly the obstacles that were faced by the early builders and how frequently a trifling decision meant fortune or failure. The story of the inauguration of the five-dollar minimum for the 8-hour day at the Ford plant on Jan. 5, 1914, is dramatically told and the adverse comments of the financiers are also given, this being one of the turning points in the industry. There are also many other interesting incidents that bear on present conditions.

PROCEEDINGS OF THE INTERNATIONAL CONGRESS FOR TESTING MATERIALS, held in Amsterdam, Holland, 1927. Two volumes. Five hundred eighty-one and seven hundred thirty-seven pages, 7¼x11 in. Cloth boards. Published by Martinus Nijhoff, The Hague, Holland. Price $12 for two volumes.

THESE proceedings will form for at least three years the only reference book in testing materials with international co-operation, since it was decided at the Congress in 1927, the first held since the War, that the next one would be in 1931. The two volumes contain 28 articles in English, 27 in French, and 41 in German, and are well illustrated throughout with photographs and large size charts. In all cases the papers appear in the language in which they were presented, and no attempt has been made to translate them into any other language.

The papers are divided into three groups dealing with metals; cement, stone and bricks; and a miscellaneous group, including oils, rubber, paints, wood and coal. In the first group will be found papers on special steels, metallography, abrasion and hardness testing, fatigue tests, magnetic analysis and miscellaneous tests of metals. Most of the articles in English were contributed by American engineers.

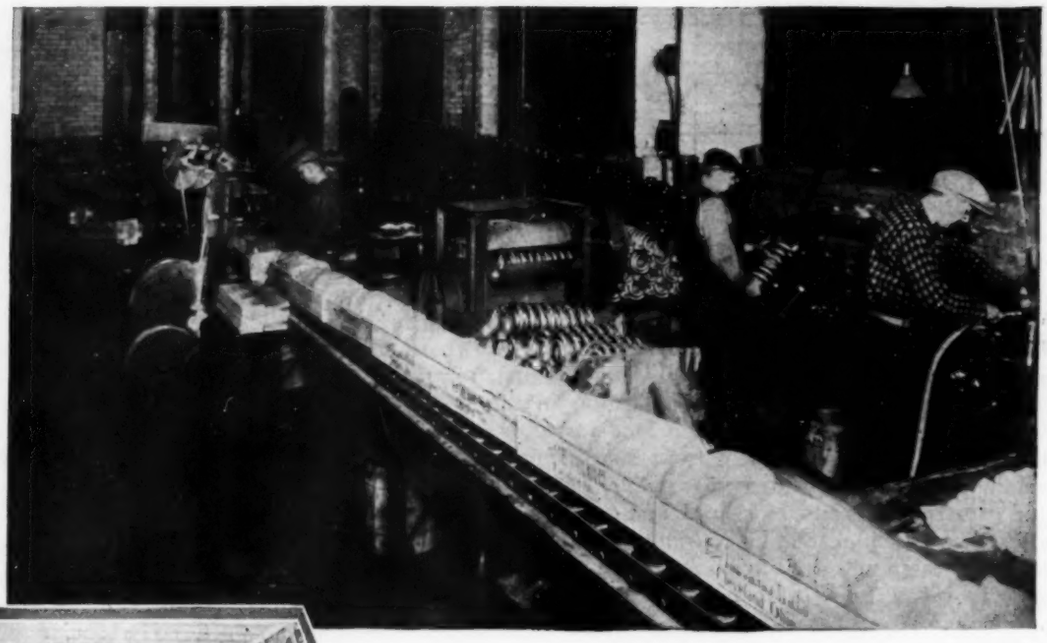
BLUE PRINT READING. By W. W. Sturtevant, instructor of mechanical drawing, South High School, Minneapolis, Minn. One hundred thirty-five pages, 9x11-in. Board covers. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York, N. Y. Price $1.90.

MECHANICAL drawing is the language of the manufacturing industry, and, to gain the basic principles is a duty of mechanics and machinists. This book has been prepared as an aid in learning as well as teaching the art. The course in blueprint reading is based on the ground that better results can be attained by having the student make drawings. In brief, the course is laid out so that it presents an effort for the expression of the pupil's ideas, and enables the instructor to check the accuracy of the impression.

The text explains the theory of orthographic projection by presenting a series of plates showing pictures of objects to be drawn arranged in such a way that the pupil can make a mechanical drawing of these objects on the facing page. When the pupil has learned the relation of views and becomes familiar with the conventional lines used, such as shown on 35 plates, the course is reversed in that the student is asked to read a number of working drawings and translate them into isometric layouts. The book is divided in three parts, the first being a brief description of mechanical drawings outlining rules and conventions, the second consisting of pictures showing objects to be drawn as working drawings, and the third a series of exercises to be copied by the pupil.

AIRCRAFT YEAR BOOK 1929. Four hundred eighty-four pages, 6x9 in. Published by the Aeronautical Chamber of Commerce, New York. Price $5.25.

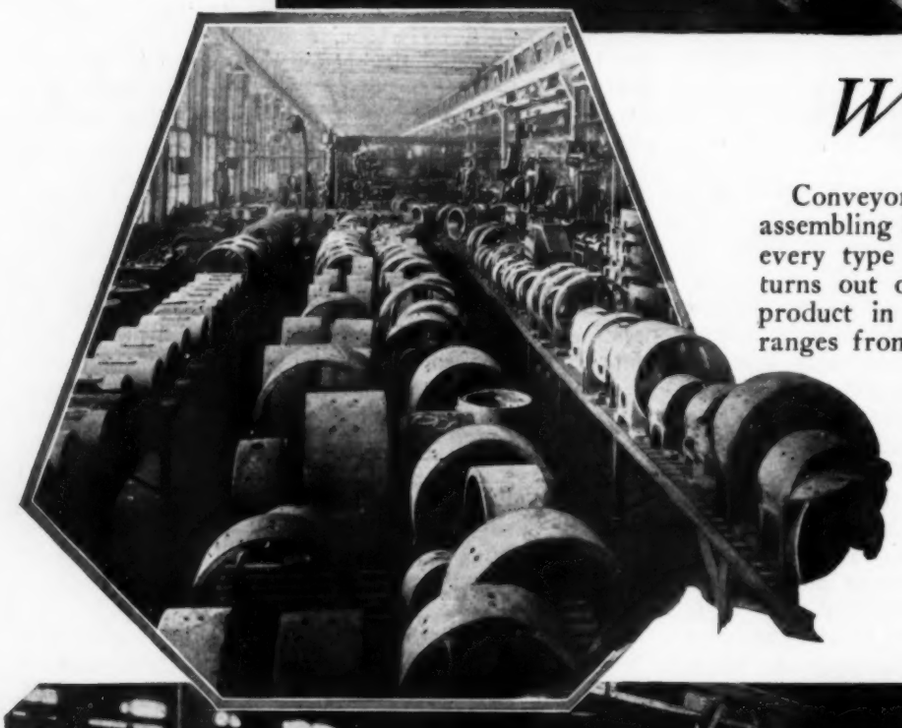
IN NO other volume can there be found such a complete and concise outline of the activities in aviation from year to year as in this Year Book. With a membership consisting of the great majority of the manufacturers of airplanes, engines and accessories, the organization is in position to secure information at first hand, and there is every evidence of co-operation between the different branches of the industry. This year's volume contains fifteen sections, besides something over one hundred pages in an appendix that is filled with data as to performance of planes, records, air mail contracts, air transport lines, army and navy equipment and about everything that pertains to aircraft development. During the year, for example, licensed aviators increased from 1,500 to 11,000; air lines flew over ten million miles in 1928, or double the distance flown in 1927; air mail increased three times, and air passengers four times in the same period. The volume makes an excellent reference in all things pertaining to aeronautics.



In the manufacture of water heaters, casings are stacked on a feed line leading to an assembly station where coil units are installed. After wrapping and putting them into shipping crates, the heaters are carried to a nailing machine by gravity conveyors. Another conveyor delivers the heaters to the shipping room

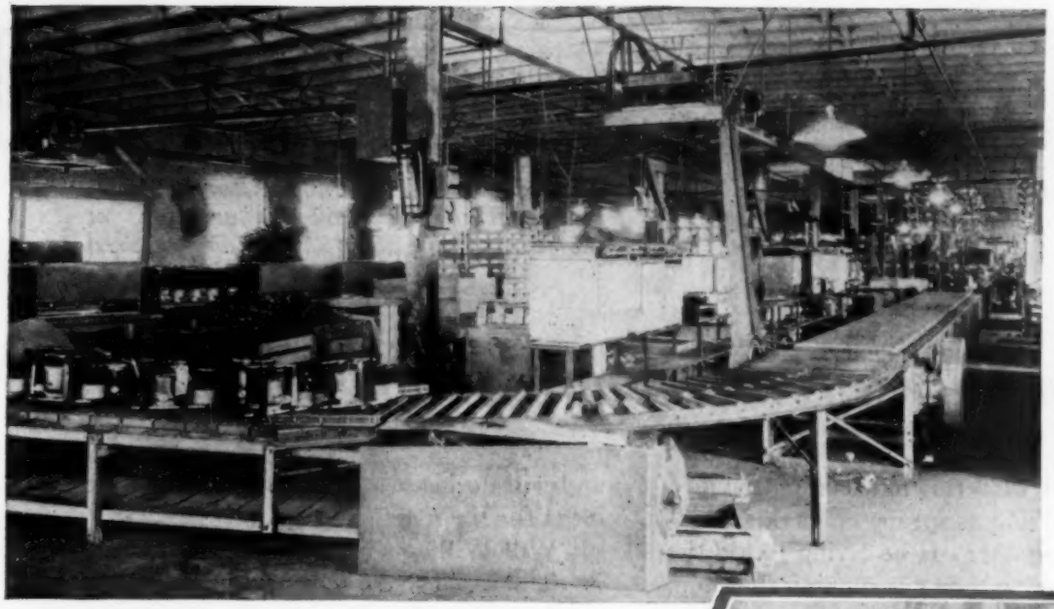
Where Conveyors

Conveyor methods of production and assembling have been applied in practically every type of metal-working plant which turns out one or more standard lines of product in volume. Equipment installed ranges from individual units for the work



Conveyors are cost savers when performing assembly operations on moderate-sized units produced in quantity. A gravity roller conveyor system, with additional gravity lines for the supplying of parts, facilitates the work of manufacturing motors

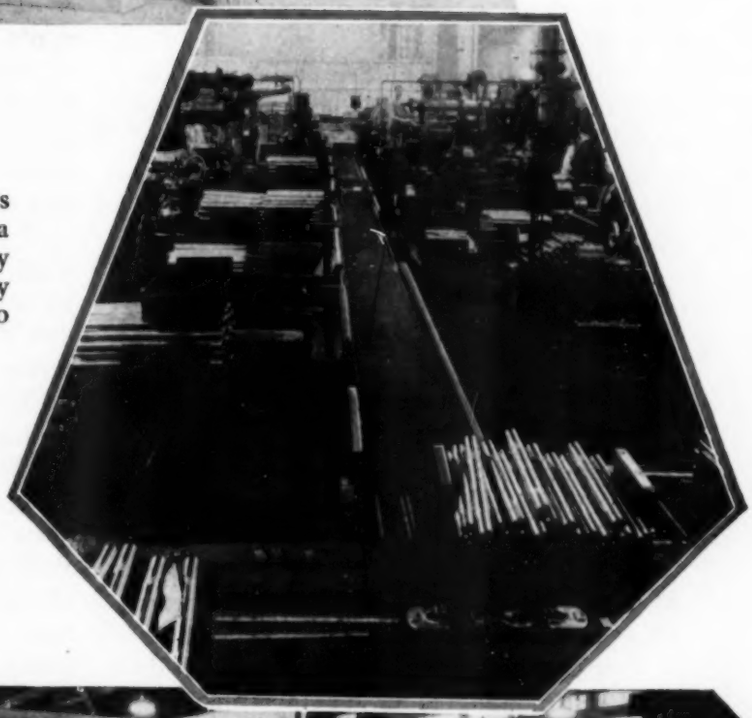
Congestion, hold-up of work, and extra handling are done away with by the conveyor equipment in this shipping room. The motors travel on a roller conveyor line, where they receive their final painting, tagging, wrapping, and preparation for shipment



Floor conveyors used in the manufacture of gas and oil ranges. A gravity roller curve in the foreground connects two sections of slat conveyors, driven by a variable-speed transmission so as to time the rate of travel according to the amount of product under manufacture

Pay Dividends

in a single department, to complete systems for the entire manufacturing cycle of a product. Such installations frequently pay for themselves within the first year. They not only save time and labor, but also greatly simplify production control.



Machining motor shafts on a straight-line production sequence, with gravity roller conveyors delivering the shafts in tote boxes or open-side carriers from operation to operation. Where the processing methods employed are in permanent use, the floor-type conveyor fits into the manufacturing scheme

Photographs by courtesy of the Standard Conveyor Company

The cost of painting operations is reduced by performing the work while the parts are on the move. Delays and extra handling are avoided. In the case illustrated, motor frames are painted on roller conveyor lines before going to assembly operations

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Committees for Definite Shop Problems

"WHAT'S this new committee idea Williams sprang on us this morning, Al? Is he trying to kid the boys into thinking they are running the shop, or what is it?"

"Williams isn't a kidder, Ed, and you know it. This committee stunt is one I suggested to him myself. Got the notion from an article I was reading one night. And it looked good enough to Williams to take a whirl at it."

"Just what's the dope, Al? Why the committees, and what are they supposed to do?"

"I guess you'd call it psychological, Ed. That's as good a reason as any. The idea is this. Take the salvage problem in any shop. Suppose we appoint a bright workman from each department and ask them to meet in Williams' office for a half hour to discuss how to reduce spoiled work."

"I don't believe it will get you anywhere, Al. Why should they bother about salvage when they get paid for production?"

"It's a hunch I have, Ed, that they'll do some real thinking about it before the meeting and dig up some real ideas. I'm banking on its effect on the men too. Every man will go home and tell the missus he's been picked to act on a committee. His stock will go up in the family circle and they'll all have a little more respect for him than they did before. He'll feel the added responsibility and will do his best to get some worth-while ideas for the meeting."

"Will Williams be there to run it? If he is they won't dare talk as freely as they would without him."

"That's one thing we don't know yet, Ed. In some ways I'd rather have Williams sit in, but he wants to try it without. If they have trouble about getting a report he'll suggest that his stenog stay in his place."

"I can't see what you're going to gain by it all. I'm afraid the men won't dare say what they'd like to, and I don't know why they should be able to dig up any more ideas because they are on a committee."

"It's all a hunch, Ed. But I can't help feeling that the fact that they are selected to consider a definite problem will spur them to doing a lot more than they would if we just posted a notice on the board for everybody. Williams will tell them he expects them to get all the ideas they can from others as well as their own, and that every man will get full credit for his ideas. Williams feels that the feeling of responsibility from being selected to act on a committee will have a good effect."

"I can't get enthused over it, Al. Perhaps you are right, but I'm from Missouri. Has it ever worked out in any shop you know of?"

"The chap who wrote the article said they had been trying it for several years, and that it worked. So we're trying it here."

Will the appointing of men or committees work out as Al hopes? Or will they be afraid to talk as Ed suggests? Should Williams or a foreman sit in on the meeting?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Keeping Posted on New Tools

"I CAN'T see why you bother about things that don't come into the day's work. I have troubles enough as it is, without lugging them home." This is the attitude that makes ordinary foremen and common workmen. The alert man always tries to stay a step or two ahead of the procession. He yearns for knowledge and satisfies his thirst by greeting with open mind all of the information from any source that he can get. By improving himself through this kind of self-training he is making himself worthy of advancement to a better place in the plant.

Constant study of things pertaining to his line of work trains a man to think, and enables him to stand on his own feet. His increased knowledge improves his ability to solve the many problems that arise in his work from day to day. As he develops the ability to meet the crises he becomes recognized as a leader in his line of work and reaps the rewards. The plums of promotion are always awarded to the men who are making their services more valuable to their employer.

—L. O. BROWN, *Toolroom Foreman, Holcomb & Hoke Manufacturing Company.*

Re-hiring Old Employees

THERE has been altogether too much stress placed upon the long service of employees. The reason this has been done has been to reduce the labor turnover. It is true, however, that if a man works only a few months and then moves on to another job he has accomplished practically nothing either of value to the employer, or in experience for himself. It is to discourage such "floaters" that much has been made of loyalty and long service.

But, on the other hand, the man who moves around after a few years gains experience which benefits his employer as well as himself. Hence, if he returns to his old shop with this added experience, he shows more loyalty than the man who was content to remain.

—HARRISON G. BROWN, *Standards Engineer, Crompton & Knowles Loom Works.*

Belts, Foremen, and Paper Work

A FOREMAN is usually held responsible for the expenses incurred in his department. It is to his advantage, therefore, to know what it actually costs to run his department; and it is particularly necessary for him not to confuse the expense of production with the expense of owning the department, the building, and the equipment.

In the matter of keeping belt costs, the foreman is in a better position to get the correct data than is the bookkeeper. While keeping costs may obviously appear to be the job of the cost keeper and not of the foreman, it is to the foreman's advantage to co-operate with the cost keeper and the accounting department in securing and reporting pertinent information, carefully classified.

Futhermore, the foreman because of his technical knowledge and experience, is in a better position to furnish correct data than the bookkeeper. It will benefit both the company and the foreman if responsibility for getting the facts as to belt costs are put up to the foreman.

—ARTHUR FRUNCILLO.

An Unemployment Fund

IN A plant where the work was seasonal and the weekly wages varied from $30 in the summer to $80 in the winter one of the men conceived the idea of establishing an "Average Hour Fund." His plan called for the funding of the money earned each week. From this fund each worker was to be paid a minimum equal to the average weekly earnings of previous years; the balance was to be turned back to the treasury of the fund. The plan was adopted by the men and a few of their number were chosen to supervise the handling of the money. Money accumulated during the busy season was to be distributed during the dull season in the form of weekly additions to their pay, the amount of this addition to be such as would bring that week's pay up to the average wage agreed upon.

The plan was put in effect and everything was satisfactory until a needy worker demanded a greater share, which was granted by the supervisor after an investigation. This led more workers to ask for extra money with the results that the money in the treasury was divided eventually and the plan was discarded.

—SAMUEL KAUFFMAN.

Going Over the Super's Head

BLACK should not have gone over the super's head, for in so doing he placed the general superintendent in an embarrassing position. By his action he has made his new assistant a matter of personal issue between himself and the "super," with a dead lock that is a distinct handicap to an ultimate solution. He has practically destroyed all probabilities of the problem being decided on the merits of the case.

It would have been better for him to have been a little patient after stating his objections to the superintendent. If he had waited, and make certain that his assistant assumed definite responsibilities after a fair period of breaking in, and then seen that he was thrown into direct contact with the super in the performance of his duties, Black would have established tangible facts on which to base further objections. No man of responsibility likes to be opposed by predictions of what might

happen, but facts are something he cannot escape. In this way the "super" might well see the necessity for changing his mind, and still be able to reverse himself with dignity. —ALBERT HOERSCH.

Shall Men Clean Their Own Machines?

A FEW years ago it was the practice in our shop to shut down 15 minutes before quitting time on Saturday to allow the men to clean their machines. There were several disadvantages in this system, the major one being the loss in production due to idle machines. Some of our machines are larger and more complicated than others and require more than 15 minutes to clean properly, others can be taken care of in less time. We employ 28 men in the shop and 15 minutes apiece is seven hours, which is seven hours lost time each week.

Our present method is to have one man work on Saturday afternoon and go over all machines. He is equipped with cleaning material and has no difficulty in covering the ground in between 4 and 4½ hours.

—L. B. JONES, *Foreman, Schlage Lock Company.*

MACHINES should not be cleaned—they should be kept clean. The operator or his helper must keep the ways and slides of machine tools free from grit and dust if excessive wear is to be avoided. A "clean-up" squad must necessarily work on a periodic schedule, and if the responsibility of keeping the machines clean is shifted from the operator, considerable damage may occur between visits of the cleaning squad.

The case cited by Williams of a steam "jenny" being used to clean machines must surely apply to rolling mills, stamping presses and similar machines, for a machine tool that is permitted to get in such condition that a "jenny" is necessary to remove the dirt, is surely indicative of poor supervision. —J. S. SWAUGER.

Letting a Big Order Go Elsewhere

FIRMS do not expand by turning orders away. When a concern definitely offers a large order, it may be reasonably assumed that it had tried elsewhere and had not been suited as to price, workmanship or delivery. Such prospective customers usually have a shrewd idea as to the capacity of your plant. If so, they will know that it means running your plant to its fullest capacity.

Shifts are undesirable in a small shop of any kind, especially if it is not located in a large industrial center. The extra supervision and employees would, when the order was completed, probably have to be paid off. No doubt Williams has been through all this before. The handling of an abnormally large order ought not in these days to cause much trouble because there is always a chance to "farm out" or sub-contract such parts of the work as the firm does not wish to do itself, to other firms who will be glad to have the work.

This, of course, will necessitate issuing of blueprints and making of extra gages, but the satisfactory handling of such an order would give work to other firms and foster a spirit of good-fellowship and co-operation. It is good business for the firm to keep its trade flag flying even if at the finish it has only just about paid its way and expanded the shop a little.

—R. L. HASELGROVE, *England.*

Al Orders an Emergency Pump

IF WILLIAMS had not made provisions for someone to take action in the event of emergencies occurring during his absence it would seem that he is to be complimented on having a foreman like Al, who has the initiative to do something constructive.

It would probably not be well to advise too much assumption of authority by foremen, but unless the purchase was a large one or involved specialized engineering problems which Al did not understand, no harm was done and the plant was kept in operation. The treasurer should remember that production is a moving force. When production stops due to a breakdown overhead goes on much the same. It is the chief task of management to maintain and facilitate the continuous flow of work. Did not the management fall down and Al do a good job? —ALLEN R. MACLAGAN.

* * * *

THE · NEXT · TOPIC

"Should Workers Buy Company Stock?"

Al Orders an Emergency Pump

Summary of the Discussion

During Williams' absence Al ordered a pump to replace one that would not function. The treasurer questioned the necessity, and claimed that the maker of the discarded pump should have made it good. Al contended that it was an emergency order and was justified by production requirements. Williams upheld Al's contention.

THE opinions expressed by the contributors to the discussion were unanimous in one respect—they all declared that Al was justified in ordering the new pump, under the conditions that prevailed, and that he met an emergency in a manner creditable to himself and with advantage to the company.

An industrial engineer opened the discussion by stating that one of the chief duties of an executive is to know when to break a rule, and that the initiative that prompts breaking it is characteristic of a competent man. A foreman declared that no one is indispensable, and as business must proceed whether executives are present or not, the foremen must take action in their absence. It was the opinion of most of the contributors that the cost of the new pump was of little importance when compared to the repair bills on the old one, and the possible loss of time on an important order. They all agreed that Williams did right in upholding Al in his contention with the treasurer.

Fundamental Action of Lubricants

By Mayo D. Hersey

Physicist and Chief of Friction and Lubrication Section
Bureau of Standards

Descriptions of four machines for measuring oiliness—An analysis of the lubrication of high-speed bearings—Action of cutting fluids

FOUR types of apparatus have been constructed at the Bureau of Standards for measuring oiliness, which may briefly be described as follows:

(1) Herschel Disk Friction Machine. In this machine friction takes place between a very light sliding element, comprising three steel balls rigidly connected, and a flat disk of bearing metal rotated very slowly about a vertical axis. The rotation of the slider is resisted by coil springs whose deflection is a measure of the frictional torque. The coefficient of friction is read directly by means of a scale and pointer.

(2) Dickinson Grooved Specimen Machine. Three steel balls are pressed against the grooved cylinder of bearing metal, which is rotated about a horizontal axis for observations of frictional resistance under high contact pressures such as may produce visible abrasion. The interior of the cylinder is water-cooled. The moment of friction is computed from the position of a counterpoise which can be moved along a horizontal arm to balance the friction.

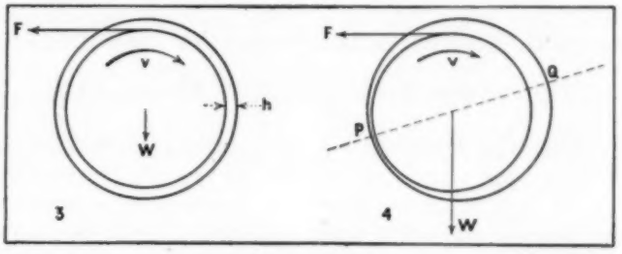


Fig. 3—Cross-section of the oil film in a journal bearing that is lightly loaded. Fig. 4—Cross-section of the oil film in a journal bearing more heavily loaded than the one shown in Fig. 3 and running at slower speed

(3) McKee Journal Bearing Machine. Test journal is held in a lathe. By mounting four identical test bearings in a tilting frame with the aid of two helical springs, a self-contained loading system is provided. This allows accurate measurement of the frictional torque acting directly upon the journal, using either full or partial bearings. Interior of journal can be water-cooled. Results are computed from counterpoise readings.

(4) Kingsbury Oil Testing Machine. Bearing blocks contain narrow, widely separated contact surfaces and are forced against the vertical steel spindle in such a way as to obtain exceedingly thin films extending over a known area. Friction torque is measured by the deflection of a torsion wire and indicated by the movement of a pointer over a circular scale attached to the table of a drill press in which the working element is mounted.

The Herschel machine is well adapted for comparative investigations of bearing metals, an important matter on account of the fact that oiliness is a joint property of the lubricant together with the metal. The Dickinson machine is believed to be especially suited for high pressure tests on cutting fluids, and was designed with this object in view. The McKee set-up gives direct observations on actual bearings. The Kingsbury machine as constructed for use at the Bureau of Standards by C. W. Staples offers the possibility of observing the rate of wear with different lubricants, and of repeating the oiliness tests at higher temperatures by means of a heated oil bath.

In tests thus far made with the Herschel oiliness machine, bearing metals high in lead content gave the lowest coefficients. These were of the order of 0.02 (two one-hundredths) and were obtained with lard oil, which has been accepted as the classical example of an "oily" oil since the date of Kingsbury's pioneer work on oiliness (Ref. 3, first part of article). From 0.02 the values go up to 0.2 or more with mineral oils on various metals. By way of contrast it may be noted that Kingsbury (Ref. 3) has reported coefficients as low as 0.0004 (four ten-thousandths), where no attempt was being made to bring out differences due to oiliness.

No scale of measurement for oiliness has been adopted other than to report the observed coefficient of friction values. These are likely to be different with the different types of machines. Oiliness measurements might conceivably be standardized either by adopting a series of pure substances as material standards of oiliness or by specifying very completely the construction and use of the machine and the procedure for preparing the test surfaces.

Before this can be done many other very interesting but exceedingly difficult problems must be overcome, notably (1) determining the conditions requisite for obtaining reproducible results with any one machine, and (2) more completely eliminating the influence of viscosity in oiliness tests.

The frictional resistance of a high-speed bearing can be computed from equation (2) in the first part of the article if the load is light enough and the machine running fast enough so that the journal occupies a practically concentric position in the bearing, as shown by Fig. 3. Multiply the length of the bearing in inches by the circumference of the journal in inches and we obtain the area A for use in equation (2); take for the uniform film thickness h one-half the difference in diameters of the journal and bearing in inches; and for v, the surface speed of the journal in inches per second. Then if Z is taken equal to the viscosity of the oil in lb.sec. per sq.in., from Table I (in first part of article) corresponding to the assumed operating temperature of the oil film, F will be the equivalent frictional resistance acting at the surface of the journal, in pounds, with a light load W

Publication approved by the Director of the Bureau of Standards, U. S. Department of Commerce, Washington.

on the bearings. The coefficient of friction is equal to F divided by W, the total load on the bearing; and the power consumed in overcoming friction is equal to $Fv/12$ ft.-lb. per sec. when v is expressed in inches per second, or $Fv/6{,}600$ horsepower.

When more heavily loaded or running at a lower speed, the journal occupies an eccentric position as shown by Fig. 4, and the calculation becomes much more complicated mathematically, although based upon the same physical principles. The wedge-shaped film automatically created by the displacement of the journal builds up positive fluid pressures on the lower side of PQ together with a partial vacuum on the upper side. This distribution of pressures forms a system of forces in equilibrium with the load W. Reference may be made to the papers of H. A. S. Howarth (Refs. 8 and 9, at end of article) for further mathematical analysis and to a series of investigations by S. A. McKee (Refs. 10-13) for experimental data on journal bearings.

A beautiful and perfect example of thick-film lubrication is to be found in the Kingsbury thrust bearing, which has superseded both ball bearings and ordinary rigid bearings for the larger hydro-electric and marine applications. The rotating mass is supported by a ring of pivoted segments, each of which takes up automatically the appropriate inclined position for the formation of a true wedge-shaped film. This type of bearing, therefore, illustrates very simply and directly the basic "inclined surface" principle of thick-film lubrication, due to Osborne Reynolds.

Incidentally, the independent development of the Kingsbury and the Michell bearings forms an interesting and important chapter in the history of engineering, both inventors attributing their inspiration to the scientific work of Osborne Reynolds. The question is frequently asked whether the pivoted-segment thrust bearing should be classed as an American or a foreign invention. The Australian engineer, A. G. M. Michell, states on page 225 of *The Illustrated Official Journal* (Patents), Vol. XXXVI, Supplement issued July 16, 1919 (London), that his study of Reynolds' theory was conducted during the years 1902-4, and his first experiments undertaken after the completion of his paper on "The Lubrication of Plane Surfaces" (Ref. 14), published in 1905. The first recorded friction measurements of Kingsbury thrust bearings, together with actual photographs of the bearings will be found in theses by H. C. Baker and H. N. Putney, on file in the Department of Mechanical Engineering of New Hampshire University (Durham, N. H.) since June, 1899. These tests were conducted under the supervision of Mr. Kingsbury in a machine specially designed and constructed by him for measuring the friction of screws and of thrust bearings (Ref. 15), and described in a paper before the American Society of Mechanical Engineers in December, 1895.

An extreme example of thin-film lubrication is to be found in the use of cutting fluids for lubricating the movement of the chip over the surface of a cutting tool, as for example in lathe operations. Cutting fluids serve both as cooling and lubricating agents, but the lubricating action, it is believed, becomes relatively more important whenever the pressure between the chip and the tool is relatively high. The cooling action becomes relatively more important with increasing speed.

Kingsbury found by microscope observations on mild steel in a cutting-off operation (Ref. 16) that the lubricant is drawn into the space between the bottom of the chip and the top surface of the tool as a result of the partial vacuum formed in the crack which precedes the point of the tool.

In view of the enormous contact pressures (probably of the order of 100,000 lb. per sq.in. in many cases) existing between the chip and the top of the tool, it is evident that the requisite lubricating properties of the cutting fluid are not those ordinarily found in oil specifications, but that the viscosity and possibly other properties of the oil should be determined under very high pressure.

An extreme example of thin-film lubrication is to be found in the use of cutting fluids. The lubricating action becomes important at high pressures between tool and work, and obviously the requisite lubricating properties are not those ordinarily found in oil specifications

A sub-committee for investigation of cutting fluids has been organized by the Special Research Committee on Cutting of Metals of the American Society of Mechanical Engineers; for a more complete account of this subject reference may therefore be made to the first progress report of the sub-committee (Ref. 16).

Properties of a Good Lubricant

The lubricant must obviously have a suitable viscosity for the machine in question, and the rate of change of viscosity with temperature should be small. A high degree of oiliness is necessary for applications where thick-film lubrication cannot be maintained, and is universally desirable as a safety precaution if it can be secured without too great an accompaniment of deleterious properties. If the lubricant serves as a cooling medium, it should have the highest thermal conductivity and heat capacity per unit volume that can be obtained, together with the lowest viscosity consistent with lubrication requirements.

The chief difficulty is to find lubricants that will not misbehave after they are once put into the machine; fatty oils, for example, would meet the foregoing requirements admirably at the start, but are liable to oxidize rapidly, with consequent gumming and corrosion.

A very interesting discussion of the requisite properties of lubricating oils for internal combustion engines will be found in the latest volume of the *Proceedings* of the American Society for Testing Materials (Ref. 17).

Fundamental research on the physical properties of lubricants and on the theory, design and practical operation of both large and small bearings has recently been planned by the Special Research Committee on Lubrication of the American Society of Mechanical Engineers in continuation of the work described in the latest published report of that committee (Ref. 18). The current program of the Special Research Committee on Cutting of Metals for investigating the action of cutting fluids

has also been cited (Ref. 16). Both programs have in common the basic problem of oiliness. Various organizations are co-operating both in the United States and abroad to formulate and attack many of the questions that must have occurred to the reader in the course of this brief review.

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Inspection—Its Technical Responsibilities

BY R. H. URE
London, England

IN ALL factories a certain proportion of the employees are engaged upon inspection work. This proportion varies according to the nature of the work, but no matter how large or how small the inspection staff is the members have now reached a position when they belong to a definite department and are not merely offshoots of the machine shop or planning department. However, it is not always realized that the inspection of a series of components, finished articles and raw materials calls for a thorough engineering knowledge plus a more-than-usual comprehension of basic principles.

Contrary to a current saying, it is *not* any fool who can say when a job is wrong. Often the testing of a piece of apparatus or machine calls for greater knowledge than was required in the manufacture or even design. It must be remembered that the function of the inspection department is to pass every part possible, always bearing in mind the quality criterion of the company.

Sometimes it is objected that since inspection has to be made to tolerances called for on the drawings or specifications it becomes nothing more than a mechanical operation, skilled, but not requiring the use of any technical knowledge. If it were possible to set limits which were commercially sound this would be true. Actually, in spite of investigation work it is a fact that limits of all kinds must be used with discretion.

Suppose for a moment that a batch or parts come out 0.0005 in. outside the tolerances set on the drawings; what is to be done? The designer says junk the whole lot, but the inspector knowing the production and output sides of the business cannot take such snap judgment. He is perfectly well aware that if he chose to work exactly to drawing or to specification the output would dwindle to an alarming extent, so he arranges for selective assembly for the particular batch.

Technically the action may be wrong, but it simply has to happen—that is all there is to it. Under ideal conditions a limit set on a drawing would be quite *the* limit, and anything outside it would cause real trouble. As it is, the fixing of limits is a job beset with the greatest of difficulties. The cost of experimenting is too high and would take too long, and so the designer has to take a directed guess with the aid of tabulated values which probably are not exactly comparable with the job in hand.

Further, the gages themselves which serve to make the drawing limits concrete are not immune to error or wear or misuse. Each of these occur, and the very best of check systems cannot cope with all contingencies.

There are many other points which have to be dealt with, but it is hoped the above will be sufficient to show that inspection is something much more than mechanical testing to set requirements.

A Method for Checking Drawings
Discussion

BY A. A. WHITE
Engineering Department, Gilbert & Barker Manufacturing Company

REFERRING to the discussion on page 743, Vol. 70, of the *American Machinist* relative to the article under the above title that appeared on page 251 of the same volume, I would like to state that from 22 years experience and in charge of checking, the elimination of checkers on drafting and design work "simply can't be done." In fact some of our largest and most successful concerns have two checkers on this class of work and feel that the expense involved is an excellent investment.

I have seen some of the best draftsmen and designers check one of their jobs two or three times and, while they would detect practically all small errors, would overlook one particular error continually, only to have it seen almost immediately by a second person.

For the same reason we find inspectors in the shops, where mechanics have been known to misread their "mikes" 0.025 in., or one turn of the spindle, and do similar stunts. Then again we have proofreaders checking printing and even railroad engineers have their firemen call out signals to check their own interpretations.

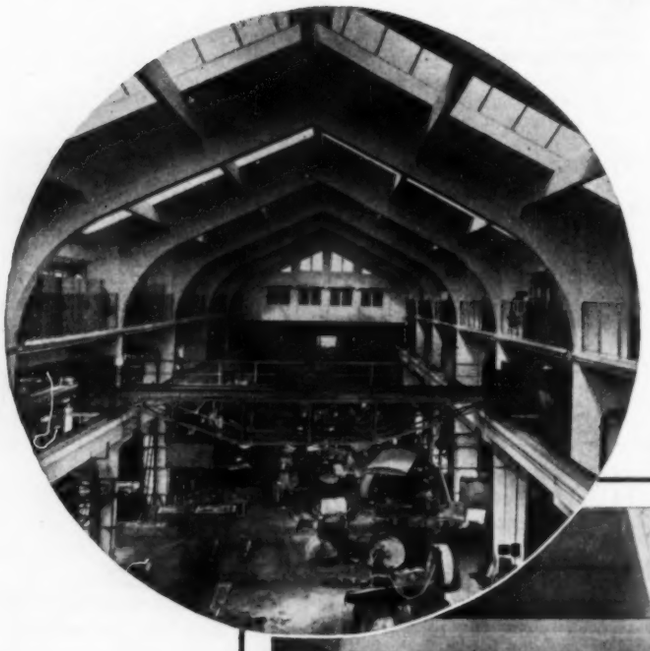
The elimination of checking in any line of endeavor would no doubt create extra caution, but in no case would it result in such a low percentage of errors. As long as humans do anything at all, they will make mistakes, even in checking their own work.

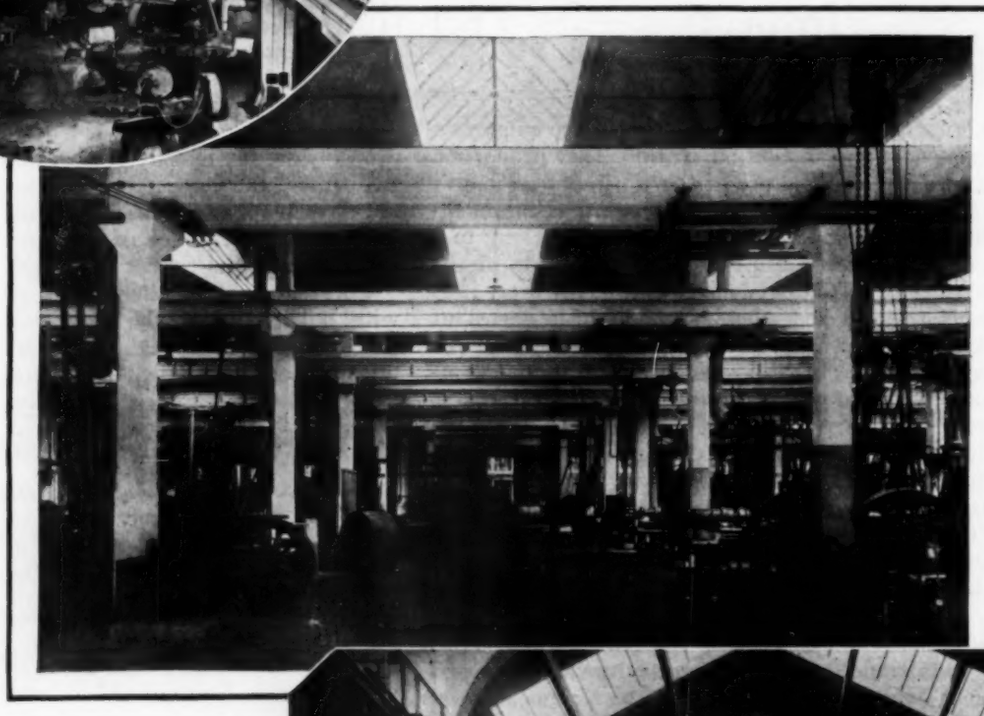
Modernization

in an Austrian Shop

By Franz Bermann
Vienna, Austria

The locomotive and tractor departments of the Locomotive Factory of the Privileged Austrian-Hungarian Railway (Priv. Oster.-Ung. Staatseisenbahngesellschaft) here shown, present an example of recent construction and layout in central European machine shops. The company employs 1,100 workmen and builds steam and electric locomotives of various sizes, Diesel engines and gasoline engines up to 150 hp., road rollers, and pumps.





As seen in the illustrations, the ceiling of the side bay is unusually high to give crane overhead, and the floor of the gallery is extended the width of the central columns. The illustration in the center shows a machine room for smaller work than is handled in the main bays. The smaller machine tools are installed in this type of building while the heavy machines and assembling floors are in the center bays of the building shown at top and bottom.

Oil-Well Drilling Equipment

By Frank W. Curtis
Western Editor, American Machinist

A group of machining operations performed in building rotary oil drilling machines and tool joints

DRILLING in the oil fields to depths exceeding a mile has brought about certain changes in the type of machinery used, due to the strains and shocks that develop when power for cutting is transmitted to such a distance. Accuracy, therefore, has become essential in machining the parts of oil-well tools and equipment, and modern machines are used to insure successful results. Materials are also selected with this point in view, so that they will withstand maximum tensile and torsional stresses.

To be in a position to fulfill these requirements led the Doheny Stone Drill Company to construct a plant at Torrance, Calif., which was put into operation last year. New machinery was purchased throughout, each unit being driven by an individual motor. The main building is 360x180 ft. in size, being divided in three bays of a width of 60-ft. each. Facilities for handling materials include four 10-ton and one 5-ton transfer cranes, six boom cranes with electric hoists, and 18 boom cranes with chain hoists.

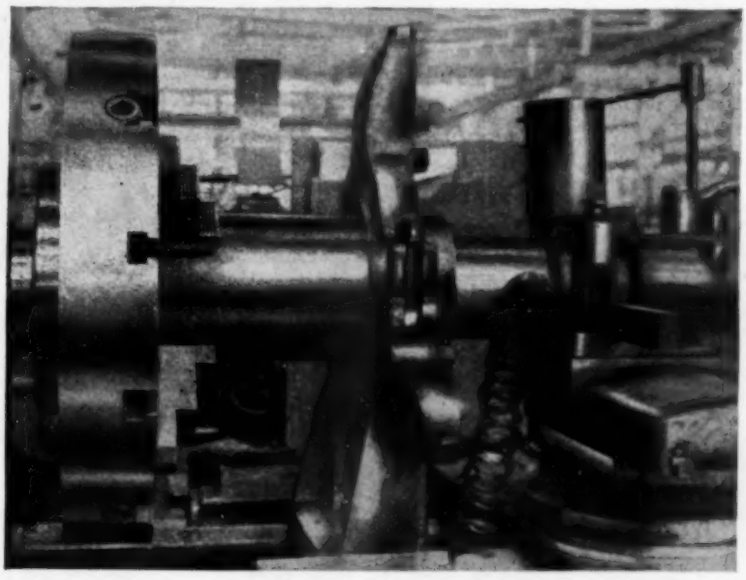


Fig. 1—Turning the tapered end of a tool joint, held by a four-jaw chuck and supported by a ball center. These joints are made in a number of sizes, of S.A.E. 3,135 steel and are heat-treated after machining

Some of the typical operations are shown in the illustrations, principally those required in building hydraulic oil-well drilling machines of the rotary type, and alloy-steel tool joints that are made in several sizes.

Bodies for the smaller-size of tool joints are made from bar stock, and the larger sizes are forged to shape, having a center hole drilled through them as the first operation. The next operation consists in turning the outside diameter and facing one end, then the joint is set up as shown in Fig. 1 for finishing the opposite end. The blank shown is a 6⅝ in. joint and is drilled 3⅛ in. in diameter, 6½ in. deep, using a steadyrest to support the projecting end. A ball center then is inserted in the hole, so that the tapered surface for the two-step thread can be finish turned. Several machines of this type are in use, since the joints are produced in fairly large quantities.

After the turning has been completed the joints are ready for threading, this operation being done in a thread milling machine such as that shown in Fig. 2. The work is transported on platform trucks, similar to the one shown at the lower left. This is the general method of handling materials from one operation to another in this shop.

A rear view of the threading operation is illustrated in Fig. 3. The threads are held to close tolerances because it is necessary to have a water-tight seal as well as to provide quick-acting features that eliminate much of the time required in extending connections to a depth of several thousand feet in the oil well. The material is S.A.E. 3,135 steel, and is threaded in two operations — roughing, and finishing. The hobbing machine is tooled to permit finish turning, facing, and chamfering at the same setting, since these surfaces are important in relation of the thread and can be handled better without removing the work from the chuck.

Crossheads for the rotary drilling machine are drilled in the horizontal boring mill illustrated in Fig. 4, which is equipped with a vertical attachment. Eight holes are completed in one setting, including two piston-rod holes 6.500 to 6.501 in. in diameter, four guide-rod holes 3.433 to 3.434 in., one bearing hole 5.908 to 5.909 in., and a sleeve hole 8.500 to 8.503 in. in diameter. The material is a 0.25 carbon steel casting. Miscellaneous transmission gears, shafting, and small cylindrical parts are finished by grinding in the machine illustrated in Fig. 5. On the truck at the right are bodies for 20-in. straight-hole roller reamers, one of the many jobs handled in the machine.

The upper head casting, which corresponds in size to the crosshead and is also of steel, is drilled and reamed in a radial drill equipped with a large open-type jig as illustrated in Fig. 6. The main part of the operation consists in the drilling of the piston-rod and guide-post holes. A near view of one of the boring setups is illustrated in Fig. 7. The cutting tool is shown at *A*, while directly above it is a boring bar guide that fits in the upper portion of the jig, shown at the bottom section of the illustration. The guide is divided into eight bearing surfaces,

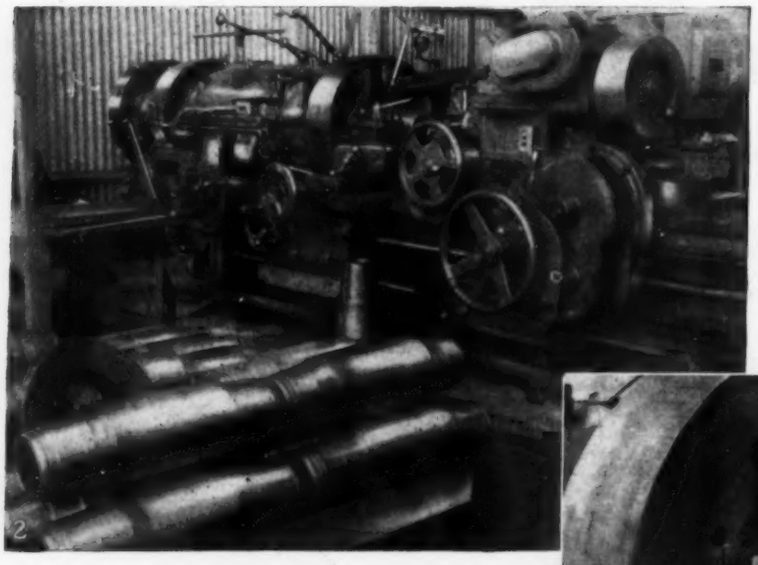
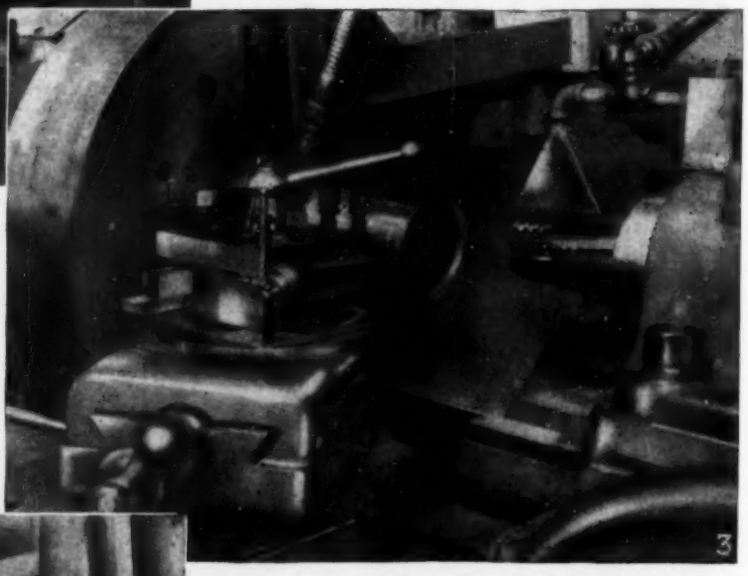


Fig. 2—One of the thread hobbing machines that cuts a two-step thread on the ends of tool joints. Some of the blanks may be seen at the lower left. A similar type of machine is used in cutting the internal thread in the box joint. The threads must be water-tight and are therefore machined with considerable accuracy

Fig. 3 — Another view of the thread-hobbing operation showing the hob in a withdrawn position. Roughing and finishing cuts are taken in order to maintain the limits required. At the same setting the joints are faced, turned and chamfered



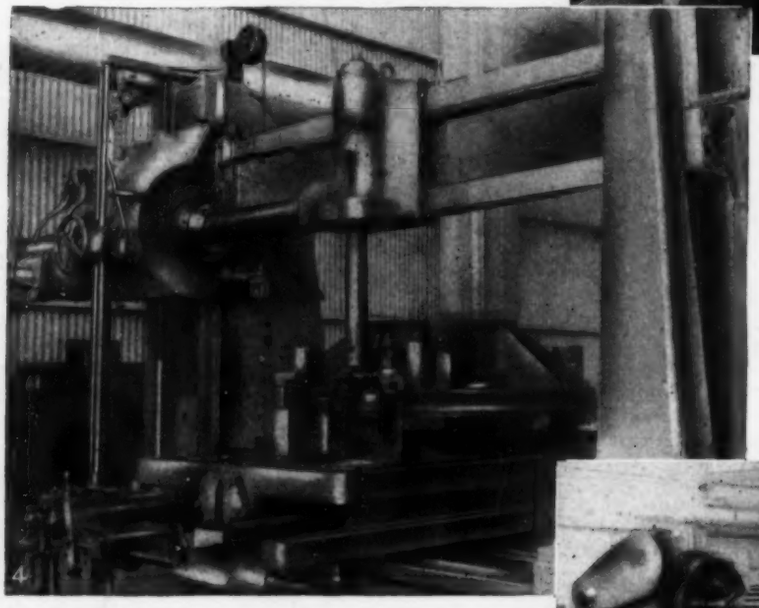


Fig. 4—One of the horizontal boring mills used in machining some of the heavier parts for the hydraulic rotary oil-well drilling machines. The part shown is a crosshead and is machined with a vertical attachment as shown. Several holes are completed at this setting

Fig. 5—Grinding is used quite extensively on heat-treated cylindrical parts such as gears and shafts. Here is shown a 16x120-in. grinder finishing a stem gear shaft to 4.000 to 4.001 in. The to 4.000-4.001 in. The parts shown on trucks are reamer bodies which are ground on six different surfaces

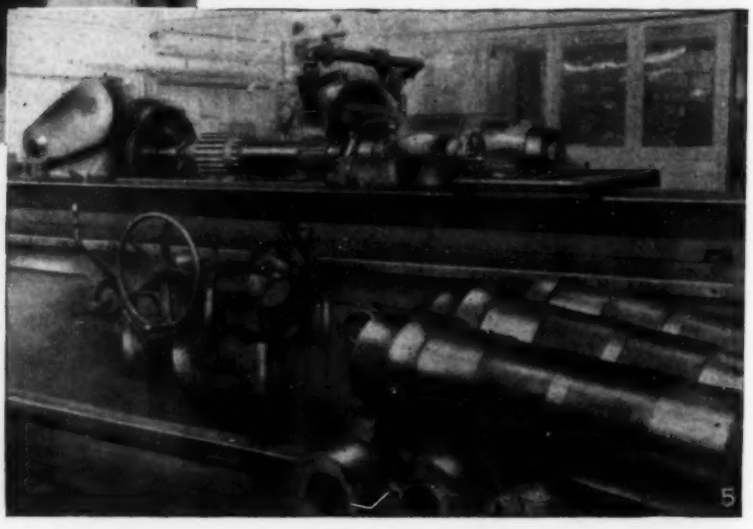
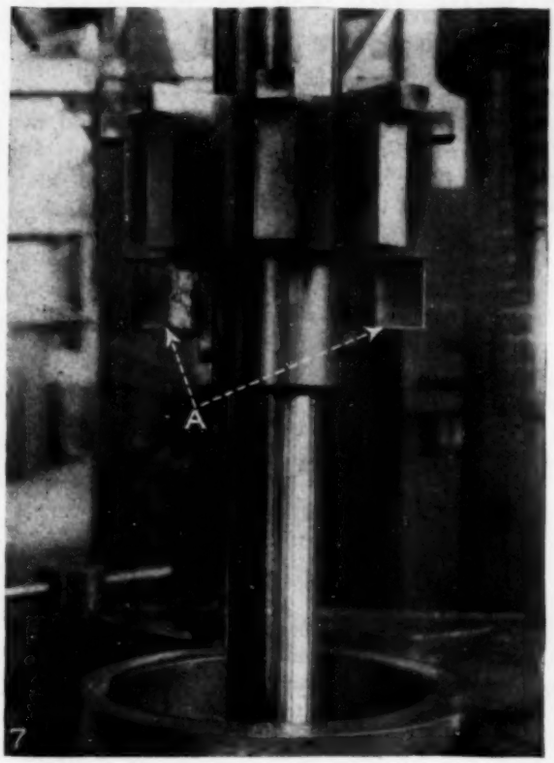


Fig. 7—A close-up view of one of the boring bars showing the double-blade boring tool and the boring-bar guide that supports the bar during the cut. The guide has eight bearing surfaces and is somewhat larger than the size of the bore to be machined



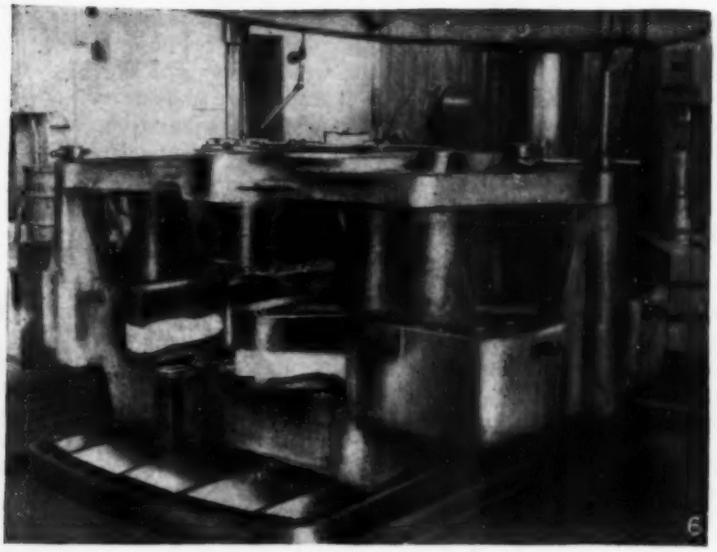


Fig. 6—Drilling of some of the larger parts requires the use of large open-side drill jigs in order to make the parts interchangeable and to facilitate manufacture. The jig shown is for drilling and reaming the important bores of the upper head

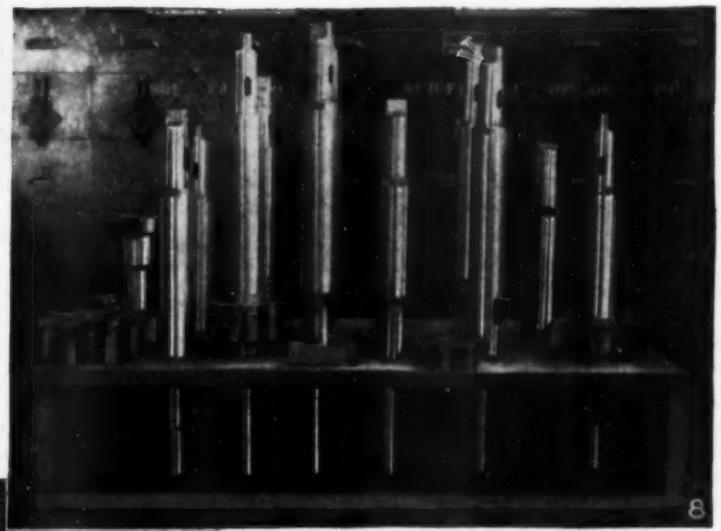


Fig. 9—One of the rotary drilling machines set up for test purposes enabling all the important mechanisms to be given a thorough operating inspection under conditions to which they would be subjected when in use

Fig. 8—On jobs requiring a number of reamers and boring bars the practice is to provide a rack for these tools, so that they can be delivered from the tool crib at one time, using a platform truck for the purpose. The rack illustrated houses all the tools required for the upper-head drilling and reaming operation

and its outer diameter is slightly larger than the size of the hole to be bored, so that the cutter can be passed through the jig to the face of the work. Some of the tools used in connection with the operation are shown in Fig. 8. The rack has provision for all the tools used on the upper-head job, and when not in use is transferred to the tool crib by means of a platform truck. Racks of this kind are used as storage space for all jobs requiring a number of setups.

One of the completed rotary drilling machines undergoing a test is shown in Fig. 9. The machine is run at operating speed and with a load comparative to that received in operation. It is run under load for a period of from 36 to 48 hours. The various sub-assemblies and units are inspected carefully for workmanship and performance, after which the machine is ready for shipment.

Moving Material on Skids—*Discussion*

By R. L. Lockwood
Division of Simplified Practice, Department of Commerce

IN LOOKING over a recent issue of the *American Machinist*, Vol. 70, I have noted particularly the article beginning on page 477, in regard to moving material on skids. The last paragraph contains certain errors which should be corrected regarding the standardization of equipment.

A general conference of manufacturers, transportation representatives, and makers of trucks and skid platforms was held to discuss the economies to be secured by extending the practice of shipping commodities on lift truck platforms. This conference decided that to bring about the simplification and standardization of equipment required for accomplishing the desired objective, the most effective means would be to establish dimensional standards for skid platforms instead of for lift trucks. Two standard clearance heights and one minimum horizontal width between runners, or supports, of skid platforms, were therefore agreed upon:

1. Clearance height from bottom of runners, or other supports, to underside of platform, 8 or 12 inches.
2. Minimum horizontal distance between inside of runners, or other supports, 29 inches.

The actual clearance between underside of skid and top of truck platform varies slightly, depending upon whether the skid is used only for inside handling around a plant, or whether it is used for shipping goods by rail, water, or highway. Most lift trucks are 7 or 11 in. high in the low position, giving a clearance of 1 in. between skid and truck. Some trucks are ¼ to ½ in. higher, where they are to be used inside a plant, on smooth, level floors, and where there is no use wasting the extra lift by providing excessive clearance. Few lift trucks 9 in. high in the low position, are in service, and practically none are being made, so the conference left this size entirely out of consideration in adopting the standards.

A Simplified Practice Recommendation, covering the skid platform standards agreed upon, was put through, and by Nov. 1 we had received a sufficient number of written acceptances from users, transportation companies and makers of equipment to warrant preparing the usual booklet. Some of the larger companies manufacturing power and hand lift trucks have already announced that their products are made in accordance with this Simplified Practice Recommendation, No. 95, which has just been published in pamphlet form.

SEEN · AND · HEARD

By John R. Godfrey

Weak Spots—Toolholders—Casehardening and Carburizing—Knowing the Effect of Alloys

THE new tungsten-carbide cutting tools, under various names, are showing up weak spots in both men and machines. In men, by emphasizing both the tendency to weigh values by the price per pound, and by claiming that present machines are O.K. for any old speed or cutting tool. But I've run across a lot of machine users who feel that it's no use even to try the new cutting tools on their present machines. And this in spite of the complacency of builders who think they are still ahead of the game.

* * * *

GENERALLY speaking, we hardly know yet what new cutting tools will do. I hear them condemned for heavy cuts or for intermittent, or "jump" cuts, when a glance at the machine shows that the tool holder might almost as well be made of rubber so far as steadiness and rigidity goes. Until we can hold cutting tools firmly and support them on tool carriages that do not deflect appreciably under a cut, we can hardly tell what the new tools will do.

* * * *

TIMES change, and with them the names of things as well as the way we use them. "Casehardening" formerly covered all the heating and quenching we did with cyanide of potassium or when we packed the iron or low-grade steel in bone or leather. Then we introduced "carbonizing" to describe the change in the material, without regard to the hardening due to quenching.

Now the combustion and chemical engineers claim a copyright on the term carbonizing, so we switch once more and call it "carburizing" as applied to steel. It isn't a new process, it's just a new name for the old method of putting more carbon into the outer portions of low-carbon steels, by any process, as distinct from the chemist's term "carbonizing" which means charring something to carbon. And it's a step in the right direction because it helps to remove opportunities for confusion. So let use remember that we now "carburize" steel before we caseharden it. All other terms are out of date.

* * * *

THE designer who wants to be thoroughly on to his job today must know quite a lot about metals and their heat-treatment, as well as other factors. He should know what kind of steel will give a very hard case and a strong core. In special cases he must know what alloys produce certain effects so as to specify more or less nickel or chromium. I ran across a case of this kind the other day, where the usual 3½ per cent nickel was not good enough for the particular job. So the designer tried 5 per cent nickel and got what he needed. It gave a 90,000 lb. tensile strength and a very hard case. Lack of knowledge might have meant failure of the machine in a critical test.

IDEAS · FROM · PRACTICAL · MEN

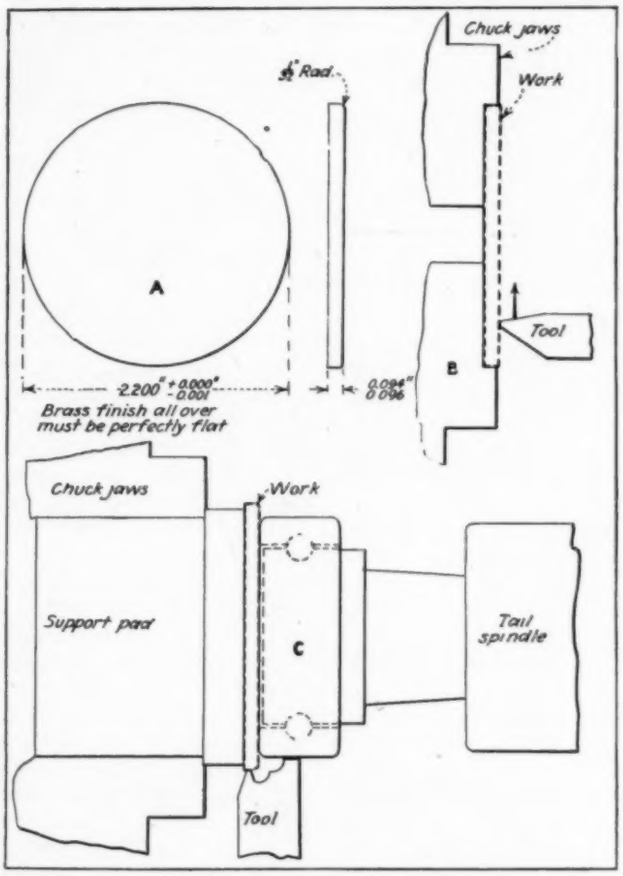
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Making Brass Disks

By H. M. Darling
Engineer, Wells Tap & Die Company

Some time ago we had an order for 500 brass disks such as the one shown at *A*. At first glance, the job looked simple enough, but the dimensions given had very close limits and most of the trouble was caused by a little note on the drawing, which said "Must be perfectly flat."

The customer furnished a bar of 2¼-in. round brass,



How the disks were held

thinking we would make the disks complete from the bar in a turret lathe. We tried this method, but found that the disks lacked a great deal of being flat. The method finally adopted was to cut the disks from the bar, leaving them from 0.010 to 0.015 in. oversize in thickness.

For the second operation, we bored out a set of chuck jaws so that the disks were gripped by the outside diameter and, at the same time, were supported nearly to the center. The disks were held in these jaws and were all faced on one side. They were then reversed in the chuck and the opposite sides were faced accurately to thickness. The micrometer stop on the carriage was used in facing them all to the same thickness. It was necessary for the operator to use considerable care in tightening the chuck jaws on the disks so as not to spring them in the least degree.

The last operation was to turn the outsides to size and to form the $\frac{1}{32}$-in. radii. We gripped a piece of round steel in the lathe chuck and faced its end accurately flat. This piece served as a support for the disks, which were held against it by a ball bearing mounted on a shank and held in the tailstock spindle, as shown at *C*. The disks were driven by friction of the supporting pad, and the tool shown at *D* finished the outside diameter and formed the radii at one pass.

Holding and driving the disks by the method described was successful, their being no appreciable distortion. The ball bearing was an ordinary radial bearing, but gave good results as a thrust bearing under the pressure imposed by the tailstock spindle.

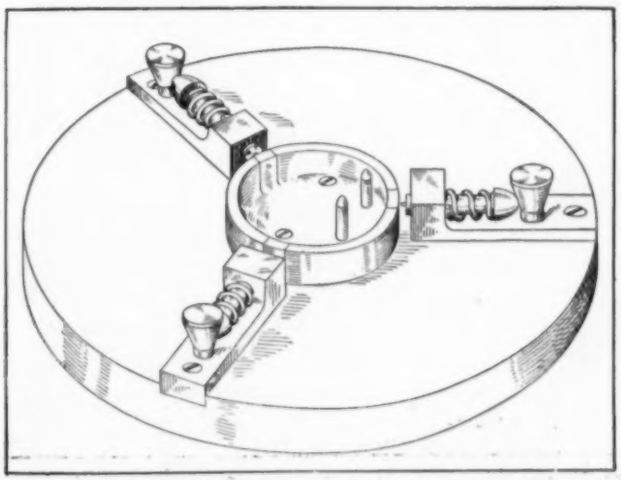
While the operations described resulted in an accurate job with fair production, I am wondering if any of the readers of the *American Machinist* can suggest a better way of doing the work.

Tools for Punching Vertical Flanges

By Chas. H. Willey
Ass't Plant Superintendent, Hoyt Electrical Works

In the design of temporary tools I am often at a loss as to how to get results without putting too much money into toolmaking. I certainly appreciate the "Ideas from Practical Men" in the *American Machinist* for showing me how the other fellow gets by.

In the sketch is shown a tool I designed for punching



Side punches operated by tapered plungers

three equi-distant holes in the vertical flanges of meter cases, the size of the holes being 0.0820 in. and the thickness of the stock being 0.020-in. soft-drawn brass.

The punches are operated by taper plungers which are forced downward by a plate in the ram of the press, and are returned by springs underneath. The punches also are withdrawn by springs. While this tool was intended for temporary use only, it has punched the holes in about 150,000 cases. Formerly the holes were drilled in a jig. Very little space on the inside of the flange made it seem difficult, at first, to do the work by punching, the total depth of the flange being $\frac{3}{16}$ in., the holes coming in the center. Experience has shown, however, that punching is easier and better.

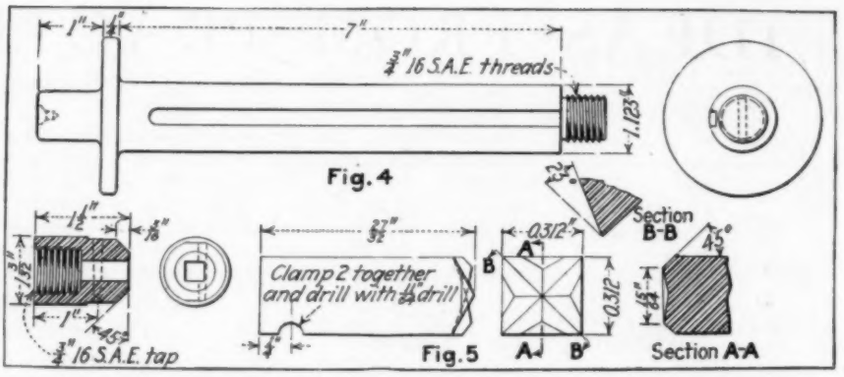


Fig. 4—The redesigned hammer ram. Fig. 5—One of the new peens

Economical Riveting Peens

By E. H. Ehrich
Master Mechanic, The Sparks-Withington Company

For the benefit of those who have similar problems in riveting in a high-speed hammer, I submit the following method of making peens: Our problem was to rivet striker pins, one of which is shown in Fig. 1, into the assembly shown in Fig. 2, using standard peens in the hammer. Because of excessive wear on the heads of the striker pins, they had to be carbonized and hardened, file hard. Since we have always had more or less trouble in keeping the small ends from being carbonized and hardened, it will readily be seen that the peens were short lived when riveting them.

To overcome the expense of frequent renewing of the peens, the hammer ram was redesigned as shown in Fig. 4, and the peens were made from $\frac{5}{16}$-in. square, cold-drawn tool steel. The steel was sawed to length and was machined in a regular productive way, thus reducing the unit cost to a small amount. All the machining was done in the toolroom by apprentices. The peens, one of which is shown in Fig. 5, are slipped through the square hole in the holder screwed to the end of the ram, and are held in place by a No. 0 taper pin. The peens bear against the hardened and ground end of the ram. It can be seen that such peens can be easily removed and replaced by new ones when worn out. By the method described, we are able to keep peens in stock at all times at a very small expense.

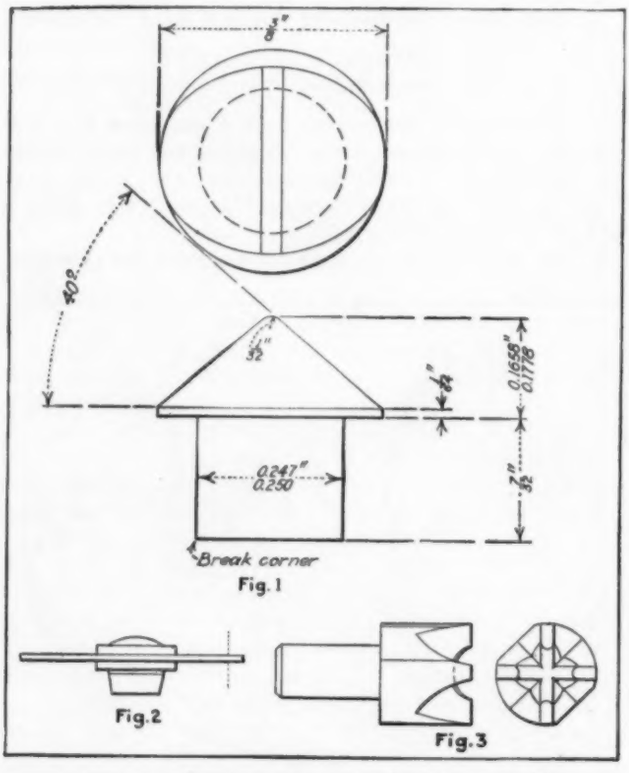


Fig. 1—The striker pin. Fig. 2—The assembly. Fig. 3—One of the peens formerly used

Expansible Threads—*Discussion*

By T. Bonsall
Earlswood, Surrey, England

Referring to the article on page 366, Vol. 70, of the *American Machinist*, it is axiomatic that history repeats itself. Is it not possible therefore that the old time mechanic with his thread chasers, stocks and dies, and broad-nose calipers, was unconsciously providing those variations of thread form and angles, that made his job stay put notwithstanding vibration due to his ignorance of dynamic balance. Many of these early mechanisms are still doing good duty, a silent testimonial to quality of work done.

I think Mr. Marion misses one point, and that is that presumably it is as unusual to find thread tools of Whitworth form in the United States, as it is unusual to find a Sellers standard in Great Britain. It is inconceivable for a firm to use two thread standards on one product.

One case only comes to mind of trying to make a Whitworth and a Sellers thread go together. A well-known American machine tool was under repair; the man detailed for the job was trying to fit a $\frac{1}{2}$-in. bolt into a tapped hole and called me in because he could not get the bolt home; he expressed himself fluently when it was pointed out that the bolt was 12 threads per inch while the tapped hole was 13 threads per inch. If a bolt must be expanded to lock, what is simpler than cupping the screw ends before slitting, dropping a steel ball into the blind hole and screwing home, a scheme which presents no unlocking trouble? Has your correspondent not seen the press notices of the Dardelet thread? Tried and approved in France, under investigation in the United States, and about to be exploited in Great Britain, the feature of this thread resolves itself into taking advantage of the locking effect of dissimilar thread angles. Hence we have two schools of

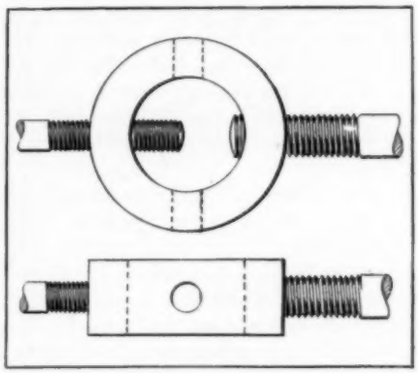
thought, one offering taps and die-chasers ground to the nth degree of accuracy, and the other school proposing to take advantage of the elastic limits of the metal, in conjunction with a predetermined locking angle on the thread.

An Improvised Turnbuckle

By Arthur Kendall
Hamilton, Canada

Needing a turnbuckle in a hurry and not having one at hand, I made the makeshift one shown in the illustration from a collar and two bolts having right-hand threads, but of different pitches.

As I had neither a left-hand tap nor die, I drilled the collar on both sides, tapping one hole with a ¾-in. 10-thread tap and the other one with a ½-in. 13-thread tap. Bolt ends of these respective sizes and pitches of threads were welded to the rods to be put under tension. Holes in the collar for a tightening bar, completed the job. It will be seen that by turning the collar, the bolt ends would be drawn toward each other by an amount equal to the difference of the pitches of their threads, or approximately 0.024 in. for each revolution, giving a very powerful pulling effect.



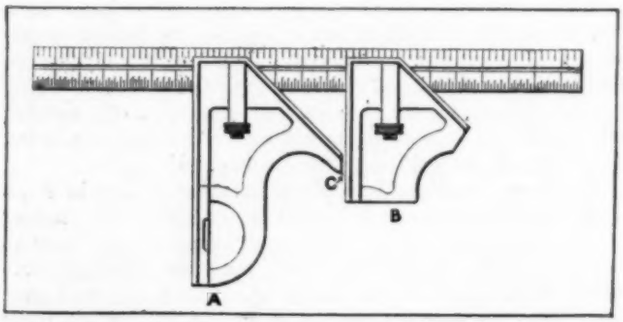
A makeshift turnbuckle

While I am aware that the principle is an old one, being that of the differential screw, I have never heard of its application to a turnbuckle. Applied as described, it enabled me to complete the work in hand without waiting for a turnbuckle to be sent from a distance.

A Useful Differential Gage

By Fred T. Smith

I have often realized how difficult it is for a workman, in gaging depths, or clearances, to hold a combination square down solidly on a parallel with one hand while using his other hand to try his "feeler" under the end of the blade. Therefore, I made the gage shown in the illustration. It consists of an ordinary combination square and an extra head. Nearly all of the angular parts of both heads are cut off as shown, and the head *A* is surface ground at *C*, parallel with the base.



Differential gage made from a combination square and an extra head

In operation, the deepest, or longest, measurement is taken first. Then the head *B* is brought up against head *A*, touching it at *C*, and locked. In taking the next measurement, head *A* is moved away from head *B*, the difference being found by the space between the two heads at *C*, using "feelers." As the scale graduations are not used in the process, a cheap square and extra head will answer the purpose. In my case, the whole outfit cost only 75 cents.

Non-Reversing Tapping Device
Discussion

By H. M. Darling

In an article under the title given above, on page 676, Vol. 70, of the *American Machinist*, Arthur Kendall describes a device for retapping nuts. While his device is very clever, most shops would use a reversing tapping-attachment for such work. An ordinary tap would be in a chuck, instead of a tap welded to a rod, as shown in Mr. Kendall's device.

I have found that a very good method of retapping nuts is to hold a regular long-shanked nut tap in a Wahlstrom quick-acting chuck, and to run the nuts on the tap until the shank is full. Then to remove the tap, take off the nuts, replace the tap in the chuck and proceed as before. By the use of such a chuck, the tap can be removed and replaced without stopping the machine.

Eliminating Machine Relieving in Built-Up Taps and Dies

By Charles B. Irmer
Supt., Direct Oxidation Process Company

Some time ago, several built-up taps and dies were made for use in our shops, and in the process of making them no machine relieving was necessary.

The principles of design are shown in Figs. 1 and 2, in which are given the essential details of the body and ring for a 3.25-in. tap and die, respectively, having 16 U.S.S. threads per inch. The body and the ring

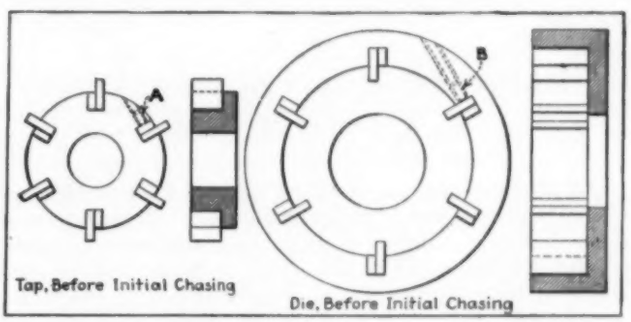


Fig. 1—Chasers in position for turning, boring and threading

each have six slots in which are placed the chasers and keys, both being secured by headless setscrews, as shown at *A* and *B*, Fig. 1. In this view the chasers are shown in the positions in which the turning, boring and thread-

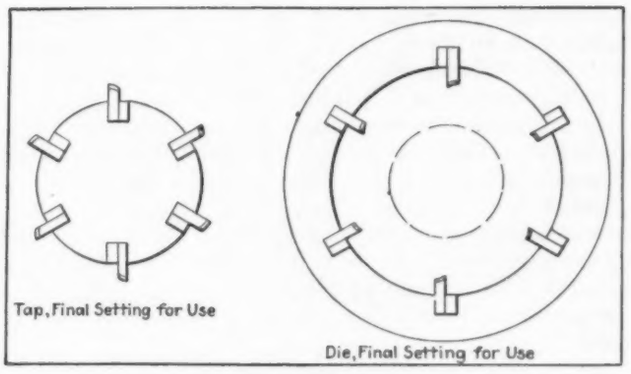


Fig. 2—Positions of chasers and keys reversed

ing were done. After this work had been completed, the positions of the chasers and the keys were reversed. The chasers, being moved ahead a distance equal to their thickness, are so positioned as to give the necessary relief, or clearance, to their cutting edges. While there is nothing new in this method of construction, it may be of interest to give the method by which the dimensions for sizing the diameters of the chaser blanks were obtained. It is evident that the chasers must be turned, or bored, to a diameter less than that of the finished tap or die. The method of making the calculations for these diameters is shown in detail in Fig. 3. Chasers turned, or bored, to the dimensions given will cut threads of 3.25 in. in diameter when they are properly assembled in the tap body and the die ring.

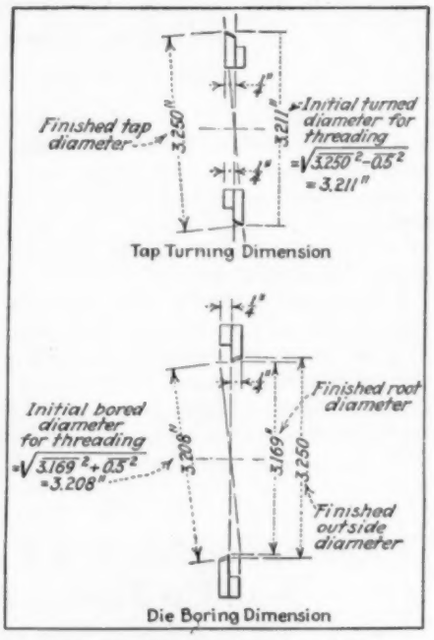


Fig. 3—Calculations for sizing diameters of chasers

Making Accurate Television Disks

By Wesley E. McArtell

Instructor, Brooklyn Technical High School

To produce accurate scanning disks for use with television receiving-sets is rather a nice job. Recently some disks that were accurate to an unusual degree were made at the Brooklyn Technical High School, and an account of how the spiral was generated will, perhaps, be of interest.

The disks, made of cold-rolled steel, had 1-in. holes in the centers and were turned to 14 in. in diameter. Each disk, in turn, was mounted on a screw arbor and was held in the dividing head of a milling machine, the spindle of which was set vertically, so that in indexing, the disk was revolved in horizontal plane. The head was set up for the proper number of divisions, 48 in this instance, and a bar carrying a bushing was attached to the column of the machine. An electric drill was used for drilling the holes as their positions were located.

The particular picture to be scanned was 1½ in. in height, which means that the spiral had to advance that distance in one revolution. The diameter of the drill for drilling the holes was the same as the amount of movement of the machine table in stepping from one hole to the next, that is 1/48 of 1,500 in., or approximately 0.31 in. The method of generating the spiral was to drill the first hole near the edge of the disk, index for the second hole, move the machine table 0.31 in. by means of the transverse feed, and drill the hole. This process was repeated for each succeeding hole in the disk.

In testing for accuracy, the disk was mounted on a mandrel and placed in front of a frosted incandescent bulb. The disk was revolved at 1,000 r.p.m. In looking at the disk through a card having a 1½-in. hole cut in it, a series of thin, black lines could be seen passing over the surface of the bulb, proving that the holes in the disk were too small. When the holes were reamed a few thousandths larger, the black lines disappeared. If the holes are too large, the lines seen on the bulb will be white instead of black.

Disks having various numbers of holes are used; 48 holes are used in the disks for scanning pictures sent out by WRNY, 2-XAL, WLEX, 1-XAY and 3-XK. In the pictures sent out by WGY, 2-XAF, 2-XAD and 4-XA, the disks have 24 holes, while those for pictures sent out by WIBO have 25 holes, and the ones for the pictures sent out by KDKA have 60 holes. Some disks have square holes, while the holes in others are wedge shaped.

When television becomes more of an accomplished fact than it now is, doubtless a fruitful field in automatically indexing and punching the holes in scanning disks will be developed.

An Ink Bottle Holder—*Discussion*

By Matthew Harris

In an article under the title given above, on page 752, Vol. 70, of the *American Machinist*, S. C. Mundy tells how to make a holder for attaching a bottle of ink to the drawing board. While the holder and the method of making it are ingenious, I think that anyone who uses it is bound to come to grief, sooner or later; not through any fault in the holder itself, but in the method of attaching it to the drawing board.

If there is any one thing that should be as stationary as possible, it is a bottle of ink. A bottle of ink in a swinging holder, such as described by Mr. Mundy, is apt to get spilled, especially if the cork is not put in tightly, or should accidentally be left out. Under such circumstances, a sudden knock against the holder would be apt to tip it up far enough to spill part of the contents of the bottle. While it is true that the ink would not be spilled on the drawing, or tracing, a big splotch of ink on the floor is unsightly and is hard to eradicate, especially if the ink is of the waterproof variety.

As shown in Mr. Mundy's illustration, I should think there would be some difficulty in attaching the holder to the drawing board. The heavy wire would have to be bent at the end after it had been put through both screw-eyes. Unless the screw-eyes were screwed part way into the board only, there would hardly be room enough to get a grip on the wire with the pliers in order to bend the short end.

Characteristics of Meehanite Metal

Meehanite metal is a gray iron which is said to have two to three times the strength, and about twice the stiffness, of ordinary cast iron, with similar casting and machining properties. It also has greater resistance to corrosion, and may be heat-treated somewhat like steel. It is especially useful for castings where non-porosity or great resistance to wear, or great strength are required. It also has a greater density than the ordinary gray iron, the specific gravity being 7.49. Technically, Meehanite metal is known as a pearlitic cast iron. The free carbon exists mostly in the form of small nodules, surrounded by a matrix of ferrite and pearlite, and when occurring in flake form these are curved and differ in size, shape, and abundance from those existing in gray iron.

Process of Manufacture

The metal can be made in an open-hearth or electric furnace, in the air furnace such as is used in making malleable iron, in the ordinary cupola, or by a combination of cupola and converter or cupola and crucible furnace.

Commercial Meehanite metal is usually produced with an average composition approximating the following:

Silicon	per cent	1.10 to 1.50
Sulphur	" "	0.05 to 0.14
Phosphorus	" "	0.10 to 0.20
Manganese	" "	0.65 to 1.00
Total carbon	" "	2.40 to 2.70

It will be noted that this metal contains about 95.5 per cent of iron as compared with 94 per cent for the semi-steels and 93 per cent for ordinary gray iron.

While the tensile strength may be varied at will from 45,000 to 60,000 lb. per sq.in. by variations in analysis and manufacture, Meehanite metal is being consistently produced with a tensile strength of 57,000, and frequently runs up to 70,000 lb. per sq.in. An elongation as high as 2 per cent is not infrequent.

Under the transverse test a standard test specimen of this material will stand, before fracture, a central load varying from 5,500 to 8,000 lb., accompanied by a deflection that is rarely lower than 0.16 in., and frequently is as high as 0.20 in. Its modulus of elasticity averages 22,000,000 as compared with say 12,000,000 for gray iron.

Microphotographs of the metal at the surface and center of a 3-in. cube show absence of segregation and uniformity of structure and grain size. The results obtained through the use of the Stanton test yield a value of 2,700 as compared with 30 on gray iron and 2,800 on malleable iron. These results indicate lack of planes of weakness such as are caused by the type of graphitic plates usually found in gray iron or semi-steel.

This homogeneous structure is said to result in considerable resistance to corrosion and oxidation under certain working conditions. For example, castings for use in handling acids bearing water, oil and gas under various conditions of pressure and temperature, are said to have shown from 30 to 300 per cent greater life than similar castings of ordinary gray iron. The explanation is given that the expansion and contraction set up by changing temperature conditions in certain types of services allow the acid to work in along the cleavage planes of the graphite in ordinary gray iron, and this effect is lessened in Meehanite metal since these plates are less in number and smaller in size.

Castings which are to be subjected to abrasion, and which do not need to be machined subsequently, can be subjected to a heat-treatment which will greatly increase the hardness. Due to the almost wholly pearlitic matrix it is necessary only to raise the metal to a red heat and quench to obtain a chilled surface reading as high as 650 Brinell. The treatment may be varied in accordance with the hardness desired. It is possible to obtain one surface hard and another soft through a local heat-treatment followed by a quench. The same hardening effect can be obtained by casting the surface to be hardened against a chill.

Should it be desired to soften a Meehanite metal casting it is only necessary to reheat the casting to a dull red and permit it to cool slowly.

Typical Uses

Some of the services for which Meehanite metal is said to be particularly suitable are as follows:

Railroad work: Rings, liners, bushings, shoes, wedges, eccentric straps, rub-plates.

Automotive work: High-grade piston rings, cylinders.

Pumps: Cylinder liners and cylinders.

Sawmills: Sheaves, gears, pulleys, rollers, dolley wheels.

Oil refineries: Fittings, valves, pipe, runner-boxes, acid pans, acid stills, absorption tower trays, bubble caps, headers, manifolds, gas traps.

Dies: Does not check nor spall like gray iron, nor hammer out like cast steel.

For machining the metal the same types of tools are used as for gray irons, and the cutting speeds and feeds are approximately the same. Since more uniform and thinner sections can be cast, it is not found necessary to allow as much metal for ordinary machining, so that considerable savings in machine time can be made. Heat-treating may be done by holding at a temperature of 1,650 deg. F. for some time and cooling in air. This treatment gives a tensile strength of 75,000 lb. per sq.in. and a hardness of 230 Brinell.

Courtesy of the Meehanite Metal Corporation

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Production Equipment Prices

ECONOMISTS of the old school cannot seem to get out of their heads the assumption that the prices asked for production equipment of various kinds follow the same path as commodity prices. Nor is this state of mind peculiar to economists. It is shared by some equipment buyers, if one may judge from the occasional request received by the *American Machinist* for information as to whether equipment prices are up or down, and what the price trend is.

Production equipment is not a commodity any more than brains, ingenuity, or designing skill are commodities. It represents a crystallization of those human attributes and as such is constantly being brought nearer to perfection.

In other words, the production equipment of today is no more like the corresponding equipment of ten or twenty years ago than the best "talking movie" of 1929, imperfect though it may be, is like the flickering motion pictures of 1909. As a consequence its price cannot be compared with the price of equipment that is in no way comparable with it. If that conception could be so stated that it would win general acceptance much of the sales resistance encountered by equipment salesmen would disappear.

As to trends, the answer is easy. The trend of equipment prices is upward, and is likely to continue in that direction so long as men with trained minds and native inventiveness set themselves the task of building machinery that is more productive and efficient than anything previously conceived.

More College Men in the Small Shop

BESIDES being the famous month of brides, when numbers of new families are formed to carry on the work of our social order, June brings into industry a vast number of young men from universities and technical schools who eventually are to assume places as leaders to carry on industrial life. How these college men are received in the plants will largely determine how useful they will eventually be to industry, and whether they will build it up to higher planes.

The value of the technically trained man has become so recognized that many large manufacturers now reach out before these boys are graduated and contract with them to take places in their plants. One of the large electrical machinery companies, which formerly gave these "student engineers" a shop training to fit them for designers and sales engineers, has now found that many of them make admirable foremen after a year or two in the shop. In this particular plant these engineer-foremen have served to bring foremanship up to a higher plane where promotion-from-within can be extended to include picking of superintendents and higher executives from the shop.

There is no apparent reason why the small shop cannot apply the same principles in absorbing technically trained men as the big plant. There has been a feeling that the "superiority complex" of these graduates unfits them for the commonplace life of the small shop, but the experience of such companies as the above has shown that the apparent snobbishness in practically all cases is little more than a great enthusiasm to break in and do things in a new way. If handled properly this can be an asset to the shop rather than a liability. Possibly with them to boost it along the small shop will not remain small.

Machine Fatigue or Lack of Foremen?

AFTER many attempts to run factories twenty-four hours a day there seems to be a general feeling that sixteen hours is more satisfactory. This period is usually divided into two eight-hour shifts, the last turn ending approximately at midnight.

There is much talk about the fatigue of machines being responsible for this limitation. It is difficult, however, to see how this can be the limiting factor. For, if a machine be kept thoroughly lubricated and in normal working condition, why should it wear out, or come to the point of repair, in continuous operation any more quickly than if run intermittently?

It seems much more likely that the real cause is in the human element. It is quite possible that a lack of sufficient supervising personnel for three shifts is one of the real reasons for the failure to obtain proportionate returns from the third shift. Few men care to work in the wee small hours which most of us feel are meant for sleep. The best men naturally seek work in the other shifts, and the best foremen can usually find employment during the more conventional hours.

Kearney & Trecker Special Gear Milling Machine

DEVELOPED for rough milling the teeth in differential gears and pinions for farm tractors on a production basis, and having capacity for 18 gears and 40 pinions per hour, the special gear milling machine illustrated has been placed on the market by the Kearney & Trecker Corporation, Milwaukee, Wis. Three 4 to 5 D. P. high-carbon, 28-tooth gears, and four 14-tooth pinions are milled simultaneously, the cutting time for a gear tooth being 17 sec., and that for a pinion tooth 16 sec. This represents an increase in production volume of 50 to 100 per cent over ordinary methods. The machine is not universal, having been built for this specific job, but can be adapted for gears or pinions with a different number of teeth, or different pitch diameter, by the addition of other fixtures. The entire operation, with the exception of loading, is automatic.

Primarily the machine is No. 1404 Mil-Waukee-Mill Simplex, equipped with a two-spindle horizontal head, and two opposed, independently-controlled, cam-operated tables. Each table carries an automatic indexing fixture, one having three spindles for the gears, and the other four for the pinions. There are two cutter arbors, one on the gear side carrying three 4 to 5 D. P. high-speed steel bevel gear roughing cutters, and that on the pinion side, four similar cutters. The arbor spindles are mounted in Timken bearings, the support bearings being made so that they can be slipped off the arbor without disturbing either the overarms or the front arm brace. The method of supporting the arbors is shown in Fig. 2. It will be noted that both the center bearing support and that for the end bearing are mounted in guides so that they can be moved vertically to correct the adjustment of the cutters with respect to the work. The arbors are fitted with a number of sleeves that hold the cutters to lateral adjustment and facilitate their removal and replacement. The sleeves are locked in position by tightening the arbor nut. The cutters revolve in opposite directions.

The tables are independently controlled by drum cams so that one side may be stopped at the out stroke for changing work or cutters without stopping the other. The cams, rollers and levers of the indexing mechanism on the tables are all made of hardened steel, and the work spindles are mounted in Timken bearings. Each work spindle is locked automatically in the index while in the cut. The arbors, work tables, and indexing mechanism are driven by a single motor through a series of horizontal and vertical gear reduction units. The work is completely inclosed while in the cut by a system of removable guards of welded sheet-steel construction. Coolant for the cutters is supplied under pressure from manifolds over the tables, and drains to a sump located in the base of the machine.

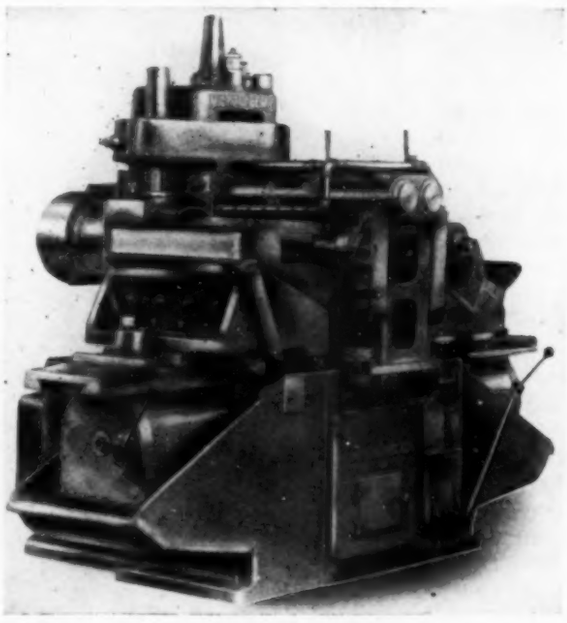


Fig. 1—Front view of the Kearney & Trecker Special Gear Milling Machine

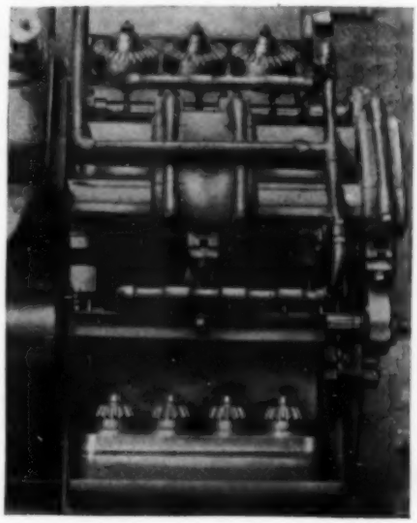
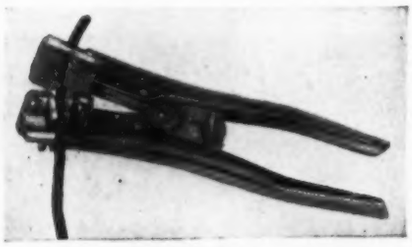


Fig. 2—Method of supporting the arbors

The sequence of operations is substantially as follows: A gear blank is placed on each of the three Timken-equipped spindles of the fixture, and the clamping nuts are tightened to hold it in place. The spindle is prevented from getting out of place during loading by an automatic spindle lock that functions at the end of the stroke. After loading the spindles, the operator trips the starting lever at the outer end of the table, and starts the table movement. The work is carried rapidly to the cutters, and slowly through the cut, when the table reverses and returns quickly to the starting point. During the reverse travel the work is indexed, ready for the next cut. The cycle is completely automatic, and is continued until the blank has been indexed and cut around its entire circumference. When this is completed the table is brought to rest at the end of the out stroke. The work is changed, and the cycle repeated. The operation of the pinion fixture is precisely the same, and takes place simultaneously. In fact, the operator can arrange matters so that he is unloading one fixture while the other is operating. Thus about 90 per cent of the maximum cutting time of the machine is utilized.

"E-Z" Wire Stripper

The wire stripper offered by the Ideal Commutator Dresser Company, Sycamore, Ill., has a triplicate action of clamping the wire, cutting the in-



"E-Z" Wire Stripper

sulation, and stripping, automatically timed and performed with one squeeze on the handles. When the pressure is released the handles open, resetting the stripper for the next set. Cutting edges are shielded, and the blind centers of the V-notches on the blades prevent cutting or scarring of the wire. The standard models strip from 10- to 20-gage, solid-core or stranded wire, and can be converted to handle larger sizes by enlarging the holes. The No. 1 standard stripper handles wires of sizes Nos. 22, 20, 18, 16, 15, 14 and 12. Standard stripper No. 2 handles wires of sizes Nos. 18, 16, 15, 14, 12 and 10. Both models are sturdily constructed.

Natco Model D13H Adjustable Multi-Spindle Drilling Machine

CLASSED as a medium size machine equipped with a hydraulic feed, the Natco model D13H adjustable multi-spindle drilling machine has been placed on the market by the National Automatic Tool Company, Richmond, Ind. It covers a large variety of work, and is flexible in its application with simplified control and ease of operation. The base of this machine is exceptionally deep and has ribs running both lengthwise and crosswise. It is extra heavy directly under the flange of the column, but is cored out in the center to allow the head counterweight maximum travel. Four lagscrew holes are provided for fastening the base securely to the floor or foundation. A wide lubricant channel extends along each side and across the front, draining into a large reservoir, which is cast in the rear of the base.

The column is very heavy and is of the box section type. The ways which support the head are 12 in. across and have a bearing 2½ in. wide and 1¾ in. deep. There are large openings in the rear of the column for adding auxiliary counterweights and an oil reservoir for the hydraulic system is located in the column near the top.

Three types of heads have been designed for this machine. They are 12x18- and 16x24-in. rectangular, arranged for either 22 or 24 spindles and 18-in. round, arranged for 12 spindles. Both are of the standard Natco design, having patented independent change of speed to each spindle, or only a single speed if desired. Either type has a neutral position for the spindles not in use. All gears are hardened and running in oil. The joints are of the improved self-oiling design and are constructed of alloy steel, hardened and ground. Two heavy T-slots are machined in the flange of the head for attaching the spindle and arm equipment.

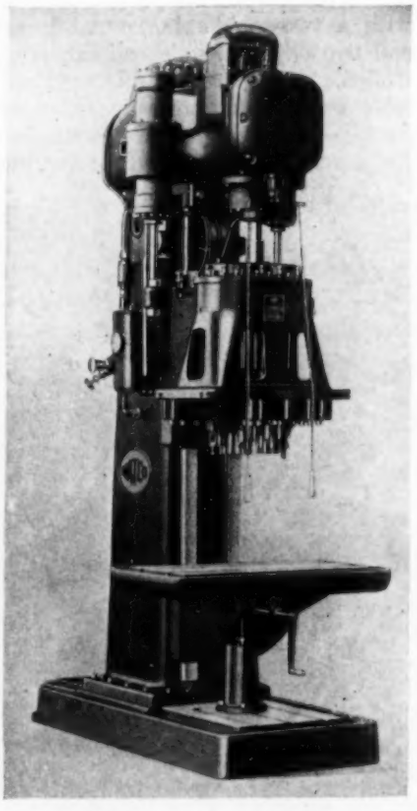
The table is of the adjustable-knee type. The minimum height of the working surface is 22 in. with 17¼ in. of adjustment. The table is raised or lowered by means of a removable crank on the front of the knee. This crank turns the adjusting screw by means of a horizontal shaft and bevel gears. The knee is supported by a long bearing on the column and by the adjusting screw, which is located directly under the center of the working area of the head. The working surface of the table is 23x40 in., and is surrounded by a lubricant channel 3½ in. wide and approximately 2 in. deep. Two T-slots which run lengthwise of the table are provided for clamping fixtures or rotary tables.

The hydraulic feed is the outstanding feature of this machine. Two 5-in. low-pressure oil cylinders are mounted in the heavy brackets at the top of the column. The maximum combined pressure of these cylinders is 8,000 lb., and is applied directly to the head flange. The control of the feed is simple and positive and was designed to leave a minimum of work for the operator. Two handles, within easy reach at all times, completely control the machine. At the start of each cycle it is only necessary to pull one of these handles to start the head travel. Rapid travel down, feeding, rapid travel up, and stopping are controlled automatically by adjustable trip dogs located on the left-hand head clamp. If an emergency stop is necessary at any time, pulling the other handle brings the head to a stop and automatically returns it to the starting position.

The pump and oil reservoir are located on and in the top of the column, respectively, the pump being gear driven from the main drive shaft. A constant-speed pump is used, and is equipped with a bypass which allows the excess oil to return to the reservoir when a given pressure has been reached. This also protects the drills should an unusually hard spot be struck, because the pressure cannot be built up beyond the correct feeding pressure.

This machine is furnished with direct motor drive. The driving power is applied through a horizontal shaft mounted in ball bearings, to a train of heavy heat-treated alloy steel change gears, then to a set of heavy heat-treated alloy steel spiral bevel gears, and then direct to the head.

The construction of the drill spindle bearing and adjustable arm is simple and sturdy. The vertical ad-



Natco Model D13H Adjustable Hydraulic, Multi-Spindle Drilling Machine

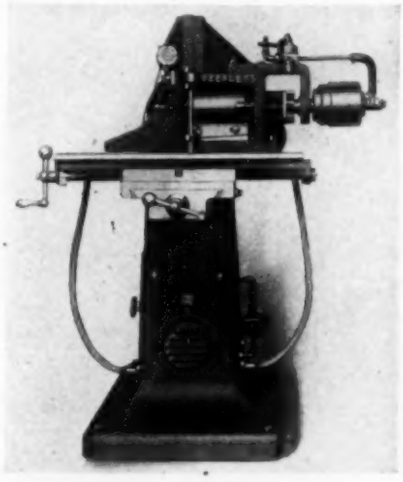
justment is made by loosening the adjusting nut, which allows the steel clamp bar to rock on the steel fulcrum, the spindle bearing is then slid on the arm to the proper position, and the screw adjusted that is carried in the strap, which surrounds the lower spindle bearing stud, so that it bears against the point of the arm. The locknut on the adjusting screw and the nut on the lower bearing stud are then tightened, locking the bearing positively in plate. The total vertical adjustment is 2 in. The spindle bearing has a tongue fitting in a grove in the adjustable arm, insuring alignment at all times.

A cascade lubricating system feeding from the drip of the pump is used to insure positive oiling. It flows by gravity to the head gear chest and from there back to the reservoir.

Specifications: Center of head to face of column, 15½ in.; top of base to bottom of head flange, maximum, 62¼ in., minimum, 43¼ in.; top of base to top of table, maximum, 39¼ in., minimum, 22 in.; head travel, 19 in.; height of machine, head up, 139 in.; range of power feed, 0 to 15 in. per min.; rapid traverse, 90 in. per min.; floor space required, 34x85 in., and weight 11,000 pounds.

"Peerless" Pneumatic Tooth Chamfering Machine

With the addition of a "Logan" air cylinder to the "Peerless" tooth chamfering machine, the production of the unit can be increased by 20 or 30 per cent, according to the maker, the City Machine & Tool Works, 1,517 East Third St., Dayton, Ohio. The machine was previously described on Page 713, Vol. 69, of the *American Machinist*. In that description, the production quoted was 45 chamfered teeth per min., depending upon the pitch and form required. The standard machine will accept gears up to 10 in. in diam., although the capacity can be increased by slight alterations in design. The spindle operates at 1,600 r.p.m. Dimensions are: Height, 49½ in.; length, 36 in., and width, 25 in. Net weight of the previous unit was 1,800 lb., but this should be increased slightly because of the addition of the Logan air cylinder equipment. The equipment is used for workholding, not indexing, and utilizes a "C" washer or an expanding mandrel.



"Peerless" Pneumatic Tooth Chamfering Machine

Fairbanks, Morse Portable Inclosed Gas Engines

A line of gasoline-kerosene engines in ratings from 1½ to 7½ hp., recently announced by Fairbanks, Morse & Company, Chicago, Ill., has been simplified in design to comprise approximately 25 per cent less parts than previously. Unit construction throughout makes the cylinder, water hopper, crankcase and bearing supports for both crankshaft and camshaft integral parts of the cylinder and base castings. The engine, with the exception of the magneto, can be entirely assembled on this casting. Removal of only two bolts permits opening the inclosure and exposes all of the working parts to view. Removal of eighteen bolts completely dismantles the entire engine.

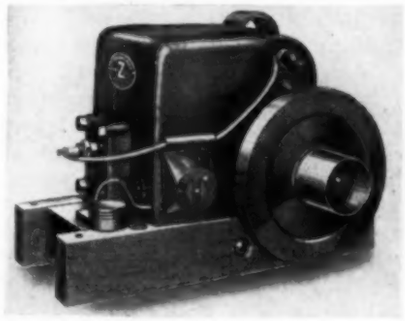


Fig. 1—Fairbanks, Morse Portable Inclosed Gas Engine

The engine is all-inclosed and is self-oiling through a special lubricating system. The base casting serves as an oil reservoir. Felt retainers on the crankshaft and camshaft, return oil grooves on these shafts, and a special crankcase breather prevent oil leakage. The breather does away with compression in the crankcase. By maintaining a vacuum within the crankcase, it also sucks in oil collected at the gaskets.

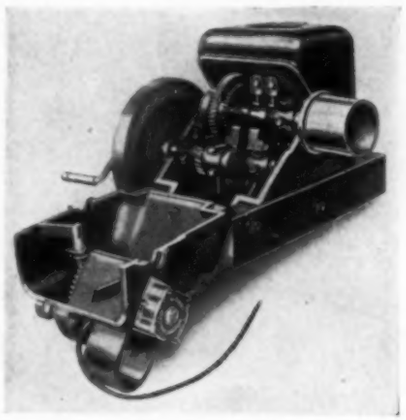


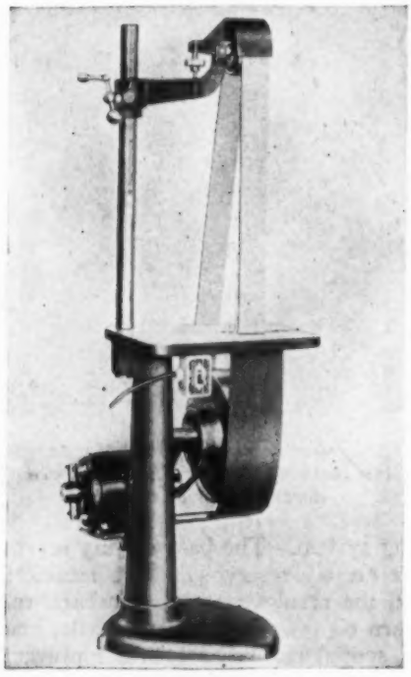
Fig. 2—Cover thrown back to expose the working parts. The two-speed arrangement is visible

The 1½-hp. size is suitable for driving portable pumps, air compressors, generators, saws, grinders, polishers, and for similar uses. It is less than 16 in. high, 22 in. long, and 19 in. wide, and weighs 150 lb. Two pulleys are provided, one of which operates at the engine speed of 1,500 r.p.m. and the other at 750 r.p.m. A mechanical regulator permits slowing down the engine to 1,100 r.p.m., with proportionate reduction in horsepower.

Porter-Cable Type B-6 Irregular Sander

For the sanding of intricate shapes, such as smoothing gates to blend on castings and forgings, polishing brass and aluminum, and other work, the Porter-Cable Machine Company, Syracuse, N. Y., has introduced an irregular belt sander. Any width of belt from ½ to 3 in. may be used. The belt passes over a pad directly above the table, against which the operator works in a manner similar to operating a bandsaw. As the belt runs in a vertical position the work is visible. Pads can be furnished in any material, thickness, and degree of pliability required.

The machine is designed for lengths



Porter-Cable Type B-6 Irregular Sander

of belt from 95 to 125 in. This provision allows more room for larger work when necessary to swing it back of the belt, and also gives greater flexibility and abrasive economy. For work requiring a very fine finish, belts with extra flexible backings are used. The device is portable and operates from a lamp socket or power line. Power is transmitted from the motor to the drive pulley by a belt which, together with the rubber covering on the pulleys over which the abrasive band travels, insures quiet operation. The type B-6 sander can be equipped in two speeds, 1,975 ft. per min. for wood or 3,425 ft. per min. for metal. Specifications are: Table, 13x19 in.; height of table from floor, 33¾ in.; travel of arm on post, 16 in.; overall dimensions, 65¾x22x27 in.; net weight 265 lb.; speed specified is for 60-cycle or d.c. motors. Equipment supplied includes: ½ hp. ball-bearing motor, 6 belts, flexible pad, and switch.

"Illium," A Corrosion-Resistant Alloy

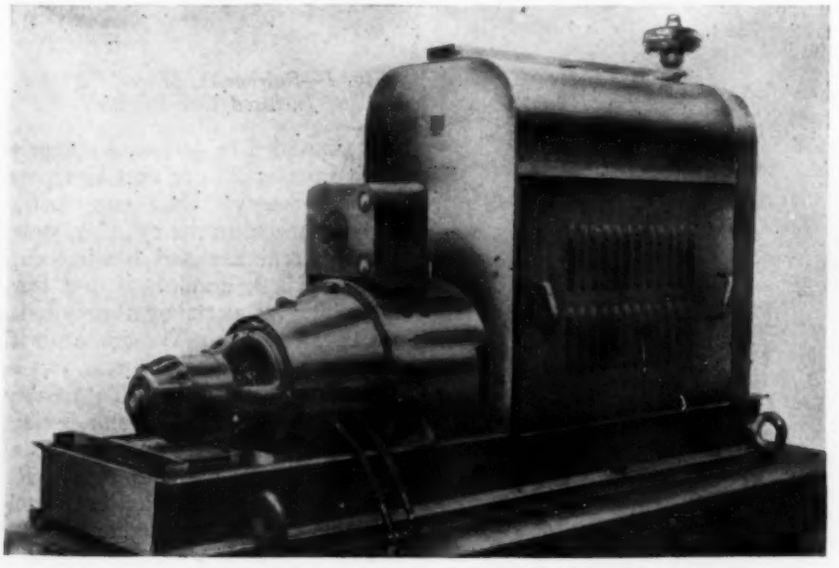
A complex alloy, known as "Illium," based on the nickel-copper-chromium ternary system, and containing small percentages of silicon, molybdenum, manganese and tungsten, has been developed by the Burgess-Parr Company, Moline, Ill. It was developed for use in calorimeter bombs, where an alloy was needed which would withstand nitric and sulphuric acids, would be sufficiently dense to resist pressures up to 1,000 lb. per sq.in. without leakage, and which would be machinable to form a perfect seal. Its resistance to corrosion has since been further tested by use where it was subject to the action of such liquids as persulphuric acid, phosphoric acid, acetic acid, and mine water. Unusual resistance to corrosion is claimed for the alloy under the attack of both organic and inorganic acids, as well as alkalis and salts.

The alloy is cast into special forms for many different purposes. It is used for pump parts, such as nuts, bolts, washers, and rotors. It also finds use in chemical plants for stirring rods and agitators. It possesses the following physical characteristics: Tensile strength, 73,000 lb. per sq.in.; elastic limit, 63,800 lb. per sq.in.; elongation in 1 in., 3.5 per cent.; hardness, Brinell, 137; torsional strength 1⅜-in. bar, 35,620 lb.; melting point, 1,300 deg. C.; specific gravity, 8.3; specific heat, 0.112; coefficient of expansion per deg. C. between 20 and 300 deg., 0.0000135; electrical resistance, 121.9 microhms cm.^{3}; contraction in casting, $\frac{5}{16}$ in. per ft.; machinability, slightly harder than cast steel.

Westinghouse 300-Ampere Gas-Engine-Driven Arc Welder

THE Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces an arc-welding set consisting of a model P-35 Continental 4-cylinder gas-engine, direct-connected to a Westinghouse type SK, 300-amp., single-operator, arc-welding generator. The generator has a special bracket which fits into the engine housing, for compactness. The control-panel is mounted on top of the generator frame and is fully inclosed by a sheet-metal cabinet. The welding current is varied over the entire range by means of a single-dial rheostat. Protective covers over the generator commutator and the engine-hood make the equipment suitable for service in all weather conditions.

This set is separately excited, the exciter being flexibly coupled to the welding generator and overhung from the front of the generator bracket. The engine has an S.A.E. rating of 28.9 hp. Under average operating conditions, the fuel consumption is approximately 1½ gal. per hr., the gasoline tank holding 28 gal. A pressure-feed system with a gear-type pump is used for lubrication. The set can be made for portable use.

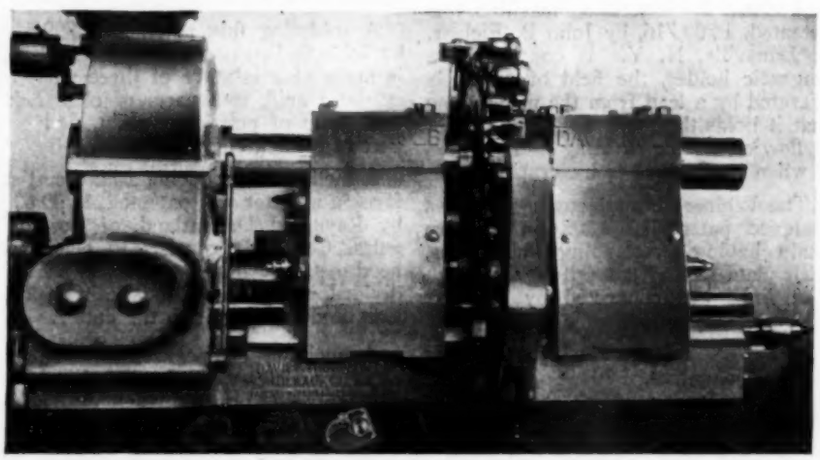


Westinghouse 300-Ampere Gas-Engine-Driven Arc Welder

Davis & Thompson No. 2-B Continuous Drum-Type Milling Machine

FOR continuous milling of housings, in particular, and castings, in general, within its range, a No. 2-B continuous drum-type milling machine has been developed by the Davis & Thompson Company, 57th Ave. & Mitchell St., Milwaukee, Wis. Each cutter head is provided with roughing and finishing cutters, and each head is slidable on its ways, and is adjustable by means of a 2-in. screw operated by means of a ratchet. The spindles are mounted in quills to allow micrometric endwise adjustment. The machine will take 42 in. between cutters and the heads can be placed as close together as desired. The whole machine has been designed, according to the manufacturer, to give very rigid construction, so that it will not chatter under the heaviest work to be done.

The work mandrel is 10 in. in diam., and the driving gears in the head are of 16-in. pitch diam. and 6-in. face. All gears are made of steel, with the exception of a large wormwheel and the bronze wormwheel for feed. The work drum is started and stopped by a clutch operated from the left-hand end of the machine, as shown. Pick-off gears govern the amount of feed past the cutters. The work drum or fixture is made in halves and clamps on the work mandrel in the same manner as a split coupling is clamped about a shaft. The parts can be mounted very readily. A long shaft drives the cutter head. The distance between the work drum mandrel and the cutter spindle is 20 in. The machine is designed to take the company's patented chain clamping equipment for holding the work in place. The weight is approximately 25,000 pounds.



Davis & Thompson No. 2-B Continuous Drum-Type Milling Machine

Victor "Super Drill" Bench-Type Drilling Machine

Through patented spindle construction, five spindle speeds are available without stopping on the Victor "Super Drill" bench-type drilling machine. The unit has been developed by the Thompson Manufacturing Company, 60 India St., Boston, Mass. The spindle speeds available are 1,600, 2,200, 3,000, 3,800 and 4,250 r.p.m. Changing the speed is effected by shifting a speed lever from one notch to another. This action causes the "Wonder Pulley Chamber," illustrated in Fig. 2 to open or close axially. Since the fingers on these two cones mesh at different radii, according to the setting of the lever, the spindle speeds are varied in accordance to how much the fingers are moved in or out. A round belt drives this conical pulley and power is transmitted to it by means of a ¼-hp. motor. An adjustable spring locking device is provided at the rear on an inclined post. This device regulates the tension of the belt and provides means for taking up the stretch. Ball bearings are provided at all points, eliminating the necessity of constant oiling, and thrust is also taken by means of ball bearings. The spindle has a travel of 2 in., and is provided with a standard Jacobs or Ettco chuck of ¼ in. capacity. The light weight of the unit permits it to be moved easily from place to place.

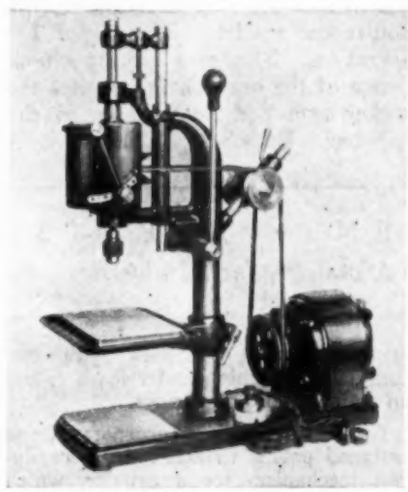


Fig. 1—Victor "Super Drill" Bench-Type Drilling Machine

Fig. 2—In or out adjustment of this patented conical pulley permits regulating the speed of the spindle

Dimensions: Base to chuck, 9 in.; table to chuck, 6 in.; chuck to main column, 5¼ in.; overall, 26x22½x12 inches.

Federal Non-Repeat Clutch-Control Mechanism for Punch Presses

Power presses built by the Federal Press Company, Elkhart, Ind., may now be furnished with a non-repeating clutch control mechanism. This equipment will function and stop the ram action after one stroke, even if the trip pedal is held down, and it re-

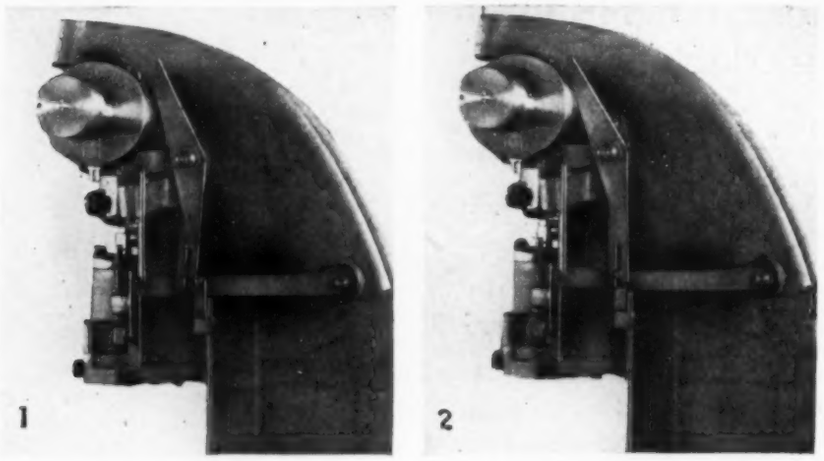


Fig. 1—Federal non-repeat clutch control in position for continuous operation of press. Fig. 2—Clutch control in position for non-repeat operation

quires the full release of the trip pedal before the ram will funcion again. Where a continuously operating press is required, the non-repeat mechanism is easily disengaged by the slipping forward of the sliding point. No screws need be removed and no adjustments are necessary.

In Fig. 1, the non-repeat mechanism is shown with slide joints set ahead of the floating pin in the trip bar, allowing continuous operation of the press. In Fig. 2 is shown the non-repeat mechanism arranged for operation. The cam on the clutch flange of the crankshaft operates the rocker arm and floating pin in the trip bar. Both are visible above.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Parts and Mechanisms

A geared headstock for lathes was patented, 1,712,766, and assigned to the Axelson Machine Co. It consists of primary, secondary, and tertiary shafts with various gear combinations, and means for driving the spindle by the tertiary shaft through backgears.

The E. J. Manville Machine Co. was assigned patent 1,713,071 on a toolholder for double-stroke solid-die headers. It includes means for adjusting the die block vertically and also means for locking the heading die and the extruding die into the block by a wedge regardless of variations in the die.

A toolmaker's clamp, patented 1,713,239, and assigned to the Brown & Sharpe Manufacturing Co., has a pair of jaws of varying lengths, one having a pair of sockets and an inner and outer threaded opening, and the other having three threaded openings. By a combination of three screws various combinations of settings can be made.

The Lodge & Shipley Machine Tool Co. was assigned patent 1,709,339 on a clutch mechanism for lathe apron transmissions. It consists of a pair of opposing clutch members with two springs for catching and releasing, and an actuator for the springs.

Cincinnati Grinders Incorporated was assigned patent 1,709,671 on a steady-rest mechanism for a grinder, which has a contact roller carried on the steady-rest shoe and positioned to engage the work.

A clamp for a welding machine was patented, 1,709,716, by John B. Fielder, of Dansville, N. Y. It consists of a magnetic holder, the field of which is operated by a lead from the machine so that it holds the work until the current is flowing during welding and releases it when the current is interrupted.

The Whitney Manufacturing Co. was assigned patent 1,709,802 on a drive chain having overlapping link plates, each plate having a tooth at each end. The links are connected by pivoting bushings.

The New Britain Machine Co., was assigned a patent, 1,703,986, on an indexing mechanism, which consists of an actuating member and a driving member, one having index slots and the other being driven by a star wheel arrangement.

An anti-friction nut patented, 1,704,031, by Rudolph G. Boehm, of Sugar Land, Texas, consists of a nut having a spiral groove in which balls are fitted and run on the spiral groove in the shaft.

Materials

An iron especially adapted for chilled rolls was patented, 1,707,332, by Frank D. Taggart, of Youngstown, Ohio. The iron contains approximately 3.5 per cent of carbon, 1.75 of chromium, 0.20 of vanadium, 1.0 of silicon, and 0.50 of manganese, with only a low content of sulphur and phosphorus.

A "scale-resisting" steel patented, 1,707,364, and assigned to the Carpenter Steel Co. contains from 3 to 30 per cent of chromium, 0.05 to 0.50 per cent of phosphorus, and less than 1.50 per cent of carbon.

A molding resin patented, 1,707,940 and 1,707,941, and assigned to the Canadian Electro Products Co., Ltd., consists of a condensation product of phenol and acetylene reacted with a catalyst.

Patents 1,712,988, 1,712,989, and 712,990 were assigned to the Dow Chemical Co., and covered the heat-treatment of light-metal alloys containing magnesium as the predominating metal. It consists in heating the articles to 800 to 820 deg. F. for approximately an hour to cause more complete solution.

A method of heat-treating aluminum castings was patented, 1,713,093, and assigned to the Bohn Aluminum & Brass Corporation. It consists in heating the alloys to a temperature as high as possible without distorting, quenching, and reheating to a temperature of 425 to 475 deg. Fahrenheit.

A welding rod patented, 1,709,474, by John B. Hawley, Jr., of Minneapolis, Minn., comprises a solid core, a flux covering the core, and a metallic jacket having annular grooves to form pockets of the flux.

A soldering flux patented, 1,709,542, by John D. Raymond, of Detroit, Mich., is made of a mixture of three parts of muriatic acid, two parts of oleic acid, two parts of powdered rosin, and one part of sodium chloride.

A method of producing a hard cutting face on a cutter was patented, 1,709,606, by Raymond D. Catland, of Los Angeles, Calif. It consists in placing a hard metal, such as tungsten, in a finely divided condition in the desired position, and welding it to the cutter.

A molding composition for making molded articles was patented, 1,709,241, and assigned to the Philadelphia Rubber Works Co. It is produced by blowing in a current of air under the influence of heat, a mixture of asphalt, an oil flux, and rubber.

News of the Week

National Conference on Weights and Measures

The twenty-second National Conference on Weights and Measures was held in Washington, June 4 to 7, inclusive. The attendance numbered 250 delegates. The conference was opened with an address by Dr. George K. Burgess, director of the Bureau of Standards and president of the conference. Doctor Burgess reviewed the status of federal weights and measures legislation which has come before Congress since the last meeting of the conference, described weights and measures publications issued by the Bureau of Standards during the past year, and discussed the recent activities of the International Bureau of Weights and Measures, particularly as regards the international temperature scale, the alternate definition of the meter in terms of the red radiation of cadmium (1 meter = 1,553,164.13 waves), and the probable adoption of 20 deg. C. (68 deg. F.) as the standard temperature for shop standards of length. He also referred to the initial steps which have been taken to bring into agreement the electrical, thermal, and mechanical units.

Secretary Lamont Speaks

On June 5 an address was delivered by the Secretary of Commerce, Robert P. Lamont, in which he pointed out the valuable work accomplished by the conference for the entire country through the exchange of ideas from the representatives of various states and cities. Without any regulatory power, and without in any way infringing upon the jurisdiction of the local governments, a high degree of uniformity in weights and measures regulation has been brought about.

Herbert L. Anderson, chief examiner of the Federal Trade Commission, described what the commission is doing to eliminate unfair practices in weights and measures in interstate commerce. He spoke particularly of the elimination of packages correctly labeled, but of unusual weight such as 15 oz. instead of 1 lb., which have a tendency to deceive the purchaser, misbranding of paint and textile materials, slack-filled packages, etc. Closer co-operation between the state and city weights and measures officials and the commission was urged by Mr. Anderson.

Papers presented by members of the bureau's staff included one on the repair of heavy-capacity scales (National Scale Men's Association Bulletin No. 1, by C. F. Howkinson, president of the association); identification by linear measurement, by W. H. Souder; and the legal status of rules and regulations as established by decision of the courts, by William Parry. The conference adopted a number of amendments to codes of specifications and tolerances for commercial weighing and measuring devices which had been previously acted upon.

A.S.T.M. Annual Meeting in Atlantic City, June 24-28

The annual meeting of the American Society for Testing Materials will be held at Chalfonte-Haddon Hall, Atlantic City from July 24 to 28. Each day except Monday will have sessions of interest to the metal-working industry. On Tuesday, the second session will deal with nomenclature, research and methods of testing. A paper, "Determination and Significance of the Proportional Limit in the Testing of Metals," by R. L. Tempin, will show the importance of the proportional limit in design and will make a comparison of proportional limit and yield point values. On Wednesday the fourth and fifth sessions will deal with cast iron, and steel and wrought iron, respectively. Eleven papers will be presented as a symposium on cast iron. On Thursday the ninth session will deal with corrosion and fatigue of metals. Two items at the eleventh session will deal with die-castings. These are: Committee report, "On non-ferrous metals and alloys," giving progress made on an extensive investigation of die-cast metals and alloys, and also silver solders; and a paper, "Aluminum Alloys for Pressure Die Castings," by Sam Tour. At the fourteenth session on Friday, five papers will be presented on non-ferrous metals, together with two committee reports.

Georgia Manufacturers To Meet This Month

The Georgia Manufacturers' Association, membership of which includes most of the larger foundries and machine shops in Georgia, will have its annual meeting and banquet at the Atlanta-Biltmore Hotel, Atlanta, on Tuesday, June 25, it is announced by J. P. McGrath, Healey Bldg., Atlanta, executive secretary. Officers for the coming year will be elected at this meeting. Among the present officers are Robert Gregg, head of the Atlantic Steel Co., Atlanta, vice-president; J. S. Schofield, of J. S. Schofield & Sons, machinery manufacturers of Macon, Ga.; Horace Lanier, head of the West Point Iron Works, West Point, Ga.; and T. E. Golden, president of Golden's Foundry & Machine Co., Columbus, Ga., who are directors of the association.

Tariff Classification of Machinery Imports

To bring about a more complete classification of machinery imports, a change in the administration provisions of the tariff act has been proposed. Except for engines, metal-working machine tools, five kinds of textile machinery, sewing machines, and ball and roller bearings, the total annual value of all machinery imported is grouped together in a basket clause at the end of the list.

Under the proposed change, all importers of machinery would be required to specify on their customs applications the type and purpose of the machines they are importing. On the basis of these figures it is believed that the domestic producers would be justified in asking for protection in all cases where types of machinery, at present unclassified, are found to exceed $50,000 a year in total value of imports.

Credit Men to Analyze Business Conditions

At the annual convention of the National Association of Credit Men, to be held in Minneapolis, June 24-29, it is expected that more than 2,000 credit executives representing manufacturers, wholesalers and banks will meet to make a study of business conditions. The business analysis will be made in trade group conferences of credit executives of more than 20 industries, including iron and steel, boots and shoes, paints and varnish, textiles, jewelry, furniture, clothing, newspapers, petroleum refineries and similar industries.

Fafnir Bearing Co. Buys Railway Motor Firm

The Fafnir Bearing Co., New Britain, Conn., has acquired the Railway Motor Corporation, De Pire, Wis., engaged in the development and manufacture of anti-friction bearings for railroad rolling stock. The new purchase will be conducted as a separate unit for the present, but it is eventually planned to center all manufacturing in New Britain, with L. W. Melcher, designer of the anti-friction bearings, in charge of their manufacture. A new company known as Fafnir Bearings, Inc., has been chartered with the nominal capital of $50,000. Its incorporators are: Maurice Stanley, president of the Fafnir Bearing Co.; A. G. Way, of Fafnir; and L. W. Melcher of the Railway Motor Corporation. This company will be operated

as a subsidiary of the Fafnir Bearing Co. with all its stock, except directors' qualifying shares, owned by the Fafnir Bearing Company.

"Textile World" Receives A. B. P. Award

For outstanding editorial service for its contribution toward the success and expansion of the rayon industry, *Textile World* has been awarded the medal of the Associated Business papers. Honorable mention was given to *Electrical Merchandising* for leading a campaign to safeguard appliance users; to *The Foundry* for its work in bringing about the formation of the Gray Iron Institute; and to *Motor Wholesale* for its contribution to progress in automotive wholesale distribution.

Wages Rise in Automotive Trade

Summaries of a study made in 1928 by the Bureau of Labor Statistics of wages in the motor-vehicle industry indicate that the average earnings were 75 cents an hour as compared with 72.3 cents in 1925 and 65.7 cents in 1922. The 1928 data were collected from 94 representative manufacturers and involved 153,962 persons, or 37.4 per cent of those engaged in the industry.

A comparison of hourly wages in 1925 and 1928 in some of the chief classifications is given below:

Occupation	Earnings per Hour 1925	1928
Apprentices	$.512	$.572
Bench hands, machine shop	.716	.724
Blacksmiths	.957	.973
Boring-mill operators	.765	.808
Crane operators	.726	.707
Die setters, sheet metal	.797	.849
Drill-press operators	.712	.734
Gear-cutter operators	.746	.760
Grinding-machine operators	.765	.792
Hardeners	.725	.749
Inspectors	.682	.723
Lathe operators	.762	.789
Machinists	.826	.844
Metal finishers	.851	.893
Milling-machine operators	.737	.764
Paint sprayers	.850	.824
Platers	.734	.756
Polishers and buffers	.908	.936
Punch-press operators	.718	.746
Sand blasters, etc	.680	.727
Tool and die makers	.875	.919
Welders and brazers	.810	.852
Welders, spot and butt	.792	.789

Average full time hours a week ranged from 48.5 to 53.4 in 1925 and from 45.3 to 53.2 in 1928, showing a slight drop in the average last year.

Industrial Earnings Up in 1928

The earnings for 1928 of 418 corporations, after deduction of all cash dividends, amounted to $1,449,583,371, an increase in the aggregate of 33.61 per cent over 1927, according to a study made by Ernst & Ernst, accountants. Statistics from metal working industries are as follows: Automobile manufacturers, number of companies reported 10, 1928 earnings $383,406, 1927 earnings $321,027; auto parts and accessories industry, number of companies reported 12, 1928 earnings $48,466, 1927 earnings $30,250; machinery industry, number of companies reported 14, 1928 earnings $130,406, 1927 earnings $120,438; metal products industry, number of companies reported 10, 1928 earnings $59,489, 1927 earnings $43,087; railroad equipment industry, number of companies reported 6, 1928 earnings $18,008, 1927 earnings $20,269.

Employment Level High in Canada

The index number of employment in Canada on May 1, based on 100 for 1926, rose to 116.2, as compared with 110.4 on April 1, and 106.8 a year ago, according to figures submitted by Assistant U. S. Trade Commissioner A. H. Thiemann, stationed at Ottawa, Canada. Pronounced improvement was reported in manufacturing, construction and transportation; appreciable gains were indicated in mining, trade, services and communications; but logging and coal mining reported less employment due to seasonal curtailment of activities.

Tests Planned on Beryllium Metal

The materials committee of the National Advisory Committee for Aeronautics is planning for tests of beryllium as a promising metal for aircraft construction. Beryllium at present is expensive and rather rare, but surveys show that the potential world supply is at least as great as that of zinc. One large source of supply has been discovered in South Africa and deposits are known to exist in parts of the United States.

Though beryllium is lighter than aluminum, it possesses about the same strength. Its modulus of elasticity is about the same as steel, or three times that of aluminum. Beryllium also is said to resist corrosion and to be practically unaffected by weather.

Simonds Prize Essay Contest for 1929

Alvan T. Simonds, president of the Simonds Saw and Steel Co., Fitchburg, Mass., offers again in 1929 $1,500 in prizes for the best essays on an economic subject. The topic selected for the present contest is "The Federal Reserve System and the Control of Credit."

Chevrolet to Expand Tarrytown Plant

The General Motors Corporation will shortly begin the enlargement of its Chevrolet plant at Tarrytown, N. Y., making it the biggest unit of the organization in point of daily output. The new structures will cost between $3,000,000 and $5,000,000, and will increase production from 700 to 1,200 cars per day. The number of employees will be increased from 2,500 to 3,500 for peak production. The addition is to be completed by Jan. 1, 1930. The Fisher Body Co. is to occupy the present Chevrolet plant, which will be devoted to the manufacture of Chevrolet bodies.

Ford Tractors Get Free Entry from Ireland

The Deputy Commissioner of Customs at Washington, after examining the various uses of the Ford tractor, has held that the machine and its parts should be admitted duty free from the plant in Ireland. The decision hinged on the classification of the tractor as an agricultural implement.

The tractor plant was moved to Ireland in conformity with Henry Ford's plans to distribute manufacturing throughout the world, rather than concentrate it in Detroit. Another reason was to make room quickly for the production of the Model A car, introduced last year. A total of 31,000 tractors, mostly for the European market will be the first year's production of the factory in Ireland. An eventual output of 125,000 machines is anticipated, of which 100,000 will be imported into America. Manufacturing costs abroad are higher, but greater horsepower and improved equipment are claimed for the product.

Machine Tool Industry In Strong Position

May orders for machine tools were again very high and indicate that machine tools are still in very strong demand, according to a report issued by Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association. However, certain signs indicate that the present rate of activity is not likely to continue indefinitely. The automotive industry is not buying machine tools in as great a ratio, compared to other industries, as in previous years. Buying has been from industries in general and indicates that manufacturers have been holding off replacements for a very long time. They now are beginning to experience the need for machines of greater productivity and utility, and are endeavoring to catch up with a replacement program which has been backward ever since the war.

More than the usual summer slowing down seems to be in sight, if present weaknesses in the demand for primary material, and a falling off in freight-car loadings, are good indicators. The tense money situation of the past two months is relaxing but rates are still high for business. The capital situation is likely to slow down general business.

Labor conditions in the industry remain about the same. Production is slowly increasing, but at the cost of overtime operation. Demand for ma-

chinists in other industries has drawn skilled labor away from machine-tool centers and is holding back production and increasing costs. The labor factor in the industry is growing in importance.

A slacking in the demand for materials indicates that hand-to-mouth buying is advisable for those companies whose requirements have not been provided for in advance at lower rates. From the equipment standpoint, the piling up of unfilled orders for up-to-date machinery indicates an existing shortage of the correct kind of machinery. Users have been experiencing limited production due to a lack of up-to-date equipment, and as they have been earning high returns on their operations, they are in the market to replace obsolete equipment with machines which will give a higher output.

The index of machine tool orders still indicates a healthy condition for the industry. The index figure for the total actual gross orders for May was 334.3, as compared with 319.7 for April and 334.4 for March. The index of three months' average of gross orders for May was 329.5, for April 330.0, and for March 320.8. For May, 1928, the total actual gross orders index was 205.4 and the three months' average total gross orders index was 216.4.

France Finds Industrial Wage Handicap

By Our Paris Correspondent

THE chief issue in France today is the obvious and all but obligatory solution of the labor wage problem, which can mean nothing else but a rise in the wage scale. The labor of the metal-working industries is particularly sensitive on this score in spite of being perhaps the highest paid of all industrial machine workers. Unquestionably the solution is the co-ordination of the wage scale with living costs. Certain specialized technical services in the engineering trades are paid on a coefficient basis which lines up fairly well with the pre-war scale. Ordinary labor, even semi-skilled labor, machine hands, etc., are mostly not. The bulk of industrial labor in the Paris district is working on a wage index basis of between 300 and 400, whereas living costs have risen from 532 in April 1928 to 615 in 1929.

By whatever yardstick the European loborer is measured, comparing him with his American brother, it will be found invariably in France he is paid but a third to a half of the wage of America. The manual labor factor is higher than the machine factor in most cost sheets in French industry.

In spite of the growing complications of the labor situation it does not seem likely that any social upheaval will supervene. The National Labor Office is calling for 2,500 hands for employment in the metal trades, but only 200 have come forward.

As a side light on the deliberations of the Debts Experts Commission which held sessions in Paris for eight weeks it has developed that Germany delivered machinery and tools on reparations account in 1928 as follows:

	Marks
Textile machinery	12,700,000
Locomotives	780,000
Machine tools	7,300,000
Agricultural machinery	1,000,000
Boilers and machinery parts	20,700,000
Other machines	4,280,000

The part of France was 52 per cent of the above total of 46,889,000 marks; that of Belgium, 12 per cent.

The French machine builders regard the approximately hundred and fifty million francs, the part of France, as being just so much lost to their own industry.

The French machine tool industry itself appears satisfactory but delivery days run from three to four months, little being made for carrying in stock. This is caused by two non-relative conditions—inability, or unwillingness, to tie up capital in the stock room; and demands of the buyer for modifications in machines which are not rigorously standardized. German imports, as much as any other, have profited from this state of affairs, and it has helped American imports also.

The automobile industry is not keeping up with delivery dates. It is probable that it is not so much a slow-down of effort, as the delays brought about by the feeble output during the winter months when preparations were being made for seasonable business which, when it came, came with a rush with which the plants were not able to cope. The motor truck industry is in an even more favorable situation if orders in hand and undelivered are considered a criterion. It seems likely that firms specializing in heavy vehicles will themselves need machine equipment which they do not yet possess, at least in sufficient quantity.

There is a growing trade developing in pneumatic, hydraulic and electric hammers, riveters and boring tools for small machine shop use. A few years ago such was scarcely heard of outside the shops of the big centers; today they are met with on all hands and the trade is growing. French manufacturers are meeting the demand so far as able. A considerable volume is of German origin and the better—also the highest priced, it may be remarked—are of American production. The American trade may be increasing in this item, but it is not holding its own as compared with the progressive competition noted. Tariff duties are 650 francs the hundred kilos. net, regardless of the weight of the unit involved.

Figures vouched for by Etienne Fougere, president of the Association for National Economic Expansion, show this year's increased production in the machinery trades for the first three months to be 13 per cent. Agricultural machine production has slowed down, seemingly because of an indisposition of distributors to extend adequate credit and for the reason that there is a feeling that most such tools and machines are of too great bulk and not suited to the small farm exploitations of France. Probably the latter is true to a large extent. Again it is claimed that farm machines are too costly. If this be so it is because methods of production are costly. Trade is by no means stagnant but few imports in this line have been brought into France during the last year. America's trade has slumped; that of Germany has increased. The latter is believed to have placed about 3 million franc's worth on reparations account in France.

It has been pointed out before that wrenches and many other small hand tools are sold here at prices which are ridiculously under those of world markets. These articles as listed and as sold seldom reach the coefficient of 4.5 as compared with 1914 prices whereas general wholesale figures hover around 600. The same is true of the steel stampings and pressings of the small stamping industries of the Ardennes which are some day due for fusion if real profits are to be made at present prices. New machinery line-ups and, above all, handling machinery for raw materials and materials in process of manufacture are recognized as something that present installations lack.

Metal-cutting and stamping machinery are growing in demand by non-centralized industries. The lines are largely catered to by French manufacturers themselves, at least a dozen firms specializing in this branch.

Machine Tool Exhibit

Machine tool exhibits at the *Foire de Paris* just opened in the *Parc des Expositions* have this year been grouped in a 40-acre area in five buildings known as the Technical Fair. A hundred exhibitors are showing machine tools—French, American, British, German, Swiss and Belgian. Conveying and hoisting machinery has more than fifty exhibitors; motors and pumps, 50; woodworking machinery, 40; road-building and excavating machinery, 30; laundry equipment, 15; machinery supplies and accessories, 100. The display as a whole exceeds any previously made at this annual sample fair, which with the annual fair at Lyons may be taken as the French reply to the famous Liepzig Fair.

The first quarter's imports from the United States increased 400 million francs in value over last year; from Germany, 280,000,000 francs; with Great Britain they were stationary. Exports to the United States fell off 500,000,000 francs; to Great Britain, 200,000,000 francs; to Germany, 500,000,000 francs. Generally speaking the fall in French exports has been on textiles and automobiles.

BUSINESS BAROMETER . . . . . *With no distention anywhere, most business men are more confident of the future than they were early in May*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

IN A politico-economic sense last week was momentous on both sides of the Atlantic. There are two views of the situation which suggest themselves to the student of current events. The weight accorded each of them will be more or less dependent upon the temperment or pre-conception of the observer.

One is described by Ramsay MacDonald in his allusions to a twentieth-century peace, and his visit to this country planned in the hope of obtaining the co-operation of the United States and President Hoover in achieving such a peace. It would include a possible or partial recognition of Soviet Russia and the establishment of the international bank visualized by Owen D. Young in his plans for collecting and disbursing the reparations that are to be paid by Germany.

Both these schemes would have been called millennial in the Victorian era or even fifteen years ago. But recent developments seem to have brought the biblical millennium somewhat nearer and it is quite possible that the business world may soon come to believe in its realization with an earnestness which may make of it a positive factor in business calculations.

The other picture is perhaps less idealistic, as its background is confined to this country and the farm relief legislation which President Hoover has succeeded in obtaining from a Congress that was somewhat reluctant to accept his recommendations.

It is doubtful whether the result will be much of an advance in the prices of those agricultural staples that have recently suffered such a decline. For this reason the bill will probably be negative rather than positive in its effect. Therefore, its enactment has caused some disappointment and it seems unlikely that it will inspire the speculative advance in the great staples that had been expected by many. But it will give great impetus to the co-operative movement which has been in the making for the last decade, and President Hoover is probably right in asserting that it will do more good than might have been accomplished by the issuance of $500,000,000 farm debentures.

But the important thing about both these views of the week's developments is that America is an essential feature of each picture, and that Europe recognizes more fully than ever before her complete financial and political dependence upon this country. As a result our position is so buttressed that it seems unlikely that there can be any serious mishap to business here. There is, nevertheless, a feeling that the decline in agricultural commodities will work a contraction in the purchasing power of the farmer, and that the result may be a mild business depression that will embrace the whole country, including the speculative markets as well as the distributive trade which reflects the hand-to-mouth buying of the public.

In the face of precedents this expectation may be a reasonable one, but sight should not be lost of the $500,000,000 for whose expenditure the Farm Relief Bill provides, as well as of the contracts that are being made by the many corporations who supplied themselves with additional capital during the period of easy money which ended about 12 months ago. Among such contracts there may be mentioned an order for $20,000,000 worth of locomotives that has recently been placed by one of the great trunk line railways, to say nothing of the extensive public works that are being planned for and undertaken by many of our larger municipalities, including the subways that are being built in New York City at a cost which exceeds that of the first transcontinental railway constructed more than sixty years ago.

Money is also becoming somewhat easier. There is less talk of extreme high rates during the crop-moving period, and the widespread apprehension of the financial situation that was felt four or five weeks ago seems to have disappeared.

For this renewal of confidence there is some basis in the present and impending arrivals of gold, the reduction of loans upon securities and the release of a moderate amount of Reserve Bank credit to the member banks through the purchase of bills and securities. The bond market is firmer and new security issues have been floated in larger quantities during the past few weeks.

For these reasons most business men feel more confident of the near future than they did early in May. There is no distention anywhere, and while the demand for merchandise does not spell a boom, it seems sufficient to absorb the production in most lines except that of cotton textiles.

Automobile output is being gradually reduced but it still breaks all records for the season, and the curtailment in iron and steel that some are predicting is still mostly deferred. But building continues to lag, and contracts awarded during May were 12 per cent less than in the same month last year.

In most other lines of business except sugar, conditions are satisfactory, and continued activity seems to be indicated for at least 60 days.

Tariff uncertainty is plaguing a good many industries and it is the next major problem for Congress to solve. The debate will contribute to seasonal quietness, and perhaps most business men will avoid commitments too far ahead until this question and the riddle of crop yields and prices are answered. But the present momentum will carry business on for some time, and easier money also makes the situation hopeful.

PROSPECTS in the machine tool and machinery field again indicate unusual activity. Some seasonal dropping off is apparent, but business is generally at a high level.

IN THE Cincinnati area inquiries are good, and small lists are open from the railroads. Buffalo reports electrical equipment makers buying well. Consolidated Aircraft has an order for 50 planes from Colonial Airways, and is reported to be planning a new factory. Kinner Motors also is expected to build around Buffalo, and perhaps one new aircraft industry. Cleveland reports increased activity. Midland Steel and Hydraulic Pressed Steel are buying. Production and employment are increasing. In Chicago, International Harvester and the agricultural implement companies are doing considerable buying. New York is most optimistic. Curtis-Caproni has put out a list of 46 machines and one of the copper interests one of 24. Airplane and radio industries are good buyers. In the New England district orders are coming from steel companies and airplane and radio plants. Production is on the increase.

MILWAUKEE reports some falling off, but airplane engines, and power farm machinery plants are buying. Philadelphia is experiencing a seasonal tapering off, but Eastern railroads are issuing small orders. Detroit also reports a falling off, except for specialized equipment. Automobile plants at present are purchasing only for replacements. However, all centers look for a big fall business.

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The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

DETROIT

Sales of machinery and machine tools in the Detroit industrial district have dropped off steadily during the past three weeks, and at present the market for general equipment is more quiet than it has been in many months. A few dealers in specialized lines report large sales totals for June, but whether even these dealers will continue to secure large orders, is problematical, in the face of the general showing up. One of the outstanding firms here has been receiving an unusually large number of inquiries during the past two weeks and expects to close more business in June than in the preceding month, and even more than in June of 1928, an unusually good month. With few exceptions the automobile plants are maintaining their heavy production schedules, but this seems to mean very little to the machinery trade. The only orders that are being placed now are for replacement machinery and for small tools and fixtures.

The belief persists here that the fall will be productive of many changes in the automobile business, and consequently will bring out many large orders for machinery and machine tools. There is a pronounced undercurrent of optimism throughout the entire trade.

CLEVELAND

Increased activity was noticeable in the local machine-tool industry for the past ten days. Various reports indicate that sales showed an increase over the previous fortnight. The feature of this improved condition was the sales to more diversified lines and smaller industrial users. An encouraging number of new inquiries were received. The Midland Steel Co. and the Hydraulic Pressed Steel Co. have issued fairly large-size lists. Present indications for the summer months are that while a slackening is expected it will not be so sharp, nor continue so long as in most years. Locally, the general industrial situation is showing improvement. Production and employment are on the increase.

An outstanding feature is the fact that tool producers are actually buying new tools. An automatic dealer reports sales in the past quarter to Kearney & Trecker, Brown & Sharpe and Pratt & Whitney.

CINCINNATI

Approximately one-half of the machine tool manufacturers in the Cincinnati district report that in the past week business held to about the same good level as in the previous six-day period. The remainder of the concerns report that there was a slight falling off in orders, but this lull is only regarded as temporary. The consensus is that in a short time there will be a general lull, for seasonal reasons, but it is not thought that the sales curve will drop to an extremely low level.

Selling agents report that in the past week business has been at a very good level, with practically no change from the previous week. The demand in local and adjacent territory, it is stated, continued to be almost altogether confined to single tools and replacements, but the aggregate sales are pronounced satisfactory. A good volume of business is pending, it is stated, and sales are expected to continue at a satisfactory level.

With the manufacturers the backbone of the week's business was the sale of single tools and replacements to general machinists and miscellaneous users. The buyers were well scattered over the country and their purchases were well diversified as to sizes and types. Sales reported as having been made to automotive concerns and railroads were confined largely to single pieces of equipment.

Manufacturers report that the week's inquiries were numerous and of good tone. The great majority of these came from general machinists and miscellaneous users, located in all sections of the country, whose requirements were almost entirely confined to single tools and replacements, including all varieties. Several small lists of requirements were received from railroads. Inquiries from the automotive field were confined to single tools and replacements.

CHICAGO

The slight recession in machine tool business noted last week has not persisted, generally speaking. While the volume of trade is not quite so large as that reported for the first half of May, practically all machinery houses seem to be satisfied with orders booked thus far this month, and do not look for any material let-up during the remainder of June. What change will occur during midsummer no one forecasts, but the general feeling is one of optimism because of the good volume of inquiries coming in, many of which will be carried over until later in the year.

Railroad buying is gradually being reduced, comparatively few items on the lists in the hands of the trade remaining to be closed. Agricultural implement and tractor builders have been doing some buying, notably the International Harvester Co., some of whose plants are being furnished with new equipment. Demand for grinding machines still continues on a good level. Business in small tools, which has been active since the beginning of the year, is showing a slight recession. Dealers in used machinery report a falling off in orders, although inquiries for standard equipment still are being received, with but little stock of high grade machines remaining on hand.

MILWAUKEE

The demand for metal-working equipment maintains a pace that appears to be uniformly satisfactory to manufacturers and dealers as well. As aptly expressed in the comment of a member of the trade, "Business is good, but we are passing from a period of taking orders to one of selling machinery." He qualified this comment by saying that no particular sort of sales resistance is developing, but the recent mad scramble for tools is subsiding. The more orderly progress of business is welcomed by the manufacturers, most of whom have enough business on their books to keep output at the present high rate throughout the summer.

While automobile factories are not nearly so active in acquiring new equipment as earlier this year, their present requirements, largely for replacements, as indicated by orders as well as inquiries, constitute a volume of no small proportions. Aircraft-engine makers are taking approximately all of the high-precision tools they can obtain. Power farm machinery manufacturers are active buyers, despite the heavy purchasing since early last fall. In fact, nearly every classification in the metal-working industry, as a whole, is represented in current orders.

The employment index is still rising, in face of the fact that the local market is kept bare of skilled machine-shop labor by the continued insistent demand for men by the metal trades. There has been a slight let-down in activities of concerns furnishing the automobile industry units, parts and equipment, but this is deemed merely a seasonal condition. Prospects generally are considered good to excellent, with a gradual settling to a more nearly normal state of affairs.

PHILADELPHIA

A tapering off in orders for machinery, machine tools and other equipment was noted by dealers and manufacturers in the Philadelphia area during the last two weeks. The situation is what had been anticipated, in view of the activities of the early summer. The decline was attributed to seasonal conditions, and also to the fact that many industrial plants, having made purchases on a rather extensive scale during the early months of the year, are now supplied and for the present are out of the market.

That basic conditions in the industry are satisfactory, is indicated by inquiries which have reached sales agents and manufacturers. Many of them bear hopeful indications for early purchases.

Some small orders for shop equipment have come from Eastern railroads, and there were some sales during the last two weeks to industrial establishments along the Eastern seaboard, which had a tendency to tone up the activities of the last fortnight. Some industrial plants in this market, which usually prepare for the summer curtailment of activities early in July, have postponed this relaxation of activities, due to some orders on hand which must be filled.

NEW ENGLAND

The current week brought out a good list of new orders for single tools, scattered over a number of industries. No outstanding lists were noted. Inquiries, however, indicate a step-up in order volume through the closing days of June. The week seemed to be more active, as a whole, than any week this month. Orders noted showed lathes, milling machines, drills, grinding machines and presses to be conspicuous in the demand. The steel industry is very active, and, with the radio and areonautical industries, was well represented in the buying. A new prospect for forging equipment developed during the week.

Industry is operating on full schedules and production is increasing from week to week. Payrolls in leading cities, as compiled from month to month, indicate a high rate of increase in man-hours. These conditions are favorable to the delivery situation, which undoubtedly, as for some time, still cuts heavily into the volume of orders placed.

The Worcester territory is one of the busiest machine-tool centers in the country. A recent survey there disclosed interesting data. The builders in Worcester are producing nearly 8 per cent of the machine tools made in the United States and exporting 10 per cent of their product. The figures show that New England's output is approximately at 30 per cent of the total.

These surveys, without exception, find a

large percentage of profitable metal-working concerns behind the times in their methods of management and the design of their products. Many plants are found equipped with old and inefficient machinery, all of which broadens the potential market for up-to-date tools.

BUFFALO

Unexpectedly for a summer month June gives evidence of being a very good month for business in the machine tool field, with electrical equipment keeping in line. While there is nothing like the amount of business which was placed in the earlier months of the year, there is, however, every reason to believe that this will be the best June in machinery sales in the Buffalo district in many years.

Orders continue to be small in most instances, but buying is so general that the aggregate is extremely good. With summer construction well under way and weather favorable the demand for contractors' equipment is good.

The airplane industry continues to hold the limelight. Besides persistent rumors that Consolidated Aircraft is planning a new plant of its own, there are also rumors that Kinner Motors is to establish a Buffalo plant. Consolidated appears to be one of Kinner's most important customers, and with the high shipping charges on motors between the Kinner plant in California and Buffalo, the move to establish a Buffalo plant for this large user appears logical. Consolidated recently closed a contract for 50 planes with the Colonial Airways group. There is also a persistent rumor that a new aircraft plant is to be located in the Buffalo area.

NEW YORK

The demand for machine tools in the New York area continues unabated. Most dealers report that June thus far is as good as May, and in some cases better. In only one or two instances has there been any real falling off in sales. There is no indication of a summer slump, and even the vacation season has not cut down either inquiries or orders.

All types of machine tools are in demand, and orders continue to be for one or two machines, on the average, rather than for large quantities. The Curtis-Caproni list, issued a week and a half ago, however, is for 46 machines; one of the copper interests has issued a list for 24 machines; and one order of 8 machine tools has been placed. Plant expansion accounts for more sales than replacement of obsolete equipment. The airplane and radio industries are most active and the light machinery market in the district is constantly growing. Inquiries and orders are particularly good for standard machines and turret lathes are especially in demand. The Western Electric and the New York Central Railroad are steady buyers, and some General Electric business is in sight.

Prices hold firm, with no indication of dropping. One manufacturer of shapers has announced a price increase of from 10 to 15 per cent, according to size of machine. Deliveries are improving, due to the tendency of makers to put through machines in larger lots. On standard lines the time quoted is from six weeks to three months.

Business Items

The Foote Brothers Gear and Machine Co., of Chicago, recently established a western sales office at 1855 Industrial Street, Los Angeles, Cal. E. D. Bennett is in charge of the reducer and gear division, and A. N. Henderson is in charge of the road machinery division in the western district. The company also announces the appointment of S. Howard Eisenberg as district representative for the States of Colorado, Wyoming and New Mexico. Mr. Eisenberg succeeds F. Ross Eberhard, and has established headquarters at 2812 Ash St., Denver.

The George D. Roper Corporation, Rockford, Ill., has begun work on the construction of a $1,000,000 plant for the manufacture of gas ranges and pumps. The work is scheduled to be completed before November 1, and all the units of the firm will then be consolidated on one site. The new building is 400x450 ft., with 180,000 sq.ft. of floor space, and will provide for a working force of 600. The plant will be of brick and reinforced concrete. The Frank D. Chase Co., Chicago, is architect.

The Linde Air Products Co. announces the establishment of a new oxygen-producing plant at 1000 West Washington Ave., Oklahoma City, Okla. S. K. Buckalow is superintendent and A. B. Curtis is district superintendent, with headquarters at Dallas, Tex. Another oxygen-producing plant has been located by the company at 150 Stockton St., Jacksonville, Fla. E. H. Blount is superintendent of the plant and J. Erskine is district superintendent, with headquarters at the Birmingham Linde plant.

The Federal Screw Works is preparing to start construction of a new addition 75x400 ft., to its Detroit plant, enabling the company to increase its capacity by about 35 per cent. It is planned to install several new departments, including an airplane parts division. An addition, 65x130 ft., has also been added to the Chelsea (Mich.) division of the Federal Screw Works, increasing the capacity of that plant by about 25 per cent. A plating department has been included in the addition.

The corporate title of the J. I. Case Threshing Machine Co., Racine, Wis., has been changed to the J. I. Case Co., effective June 1. The alteration is made advisable by the presence in the same city of two corporations making somewhat similar products and by the fact that the company's line of products has changed in the last twenty years so that "threshing machine" no longer broadly signifies the goods it manufactures.

Announcement has been made of the merger of the Mullins-Gilson Co. and the Arbuckle Foundry, both of Rushville, Ind. The Mullins-Gilson Co. has been manufacturing tractor accessories and disk cultivators. The Arbuckle foundry is equipped to produce any kind of foundry work and castings. The combination will be known as the Mullins-Gilson Manufacturing Co. Both companies have occupied sections of the same building.

Macy Conveyors, Inc., is the name of the company which will equip immediately a plant at Decatur, Ind. The charter was obtained from the secretary of state recently, showing $50,000 capital stock of no par value, with $35,000 paid in stock. The company will begin the manufacture of portable conveyors. I. W. Macy is president and general manager; John H. Heller, vice-president, and Leo Yager, secretary.

The Aluminum Co. of America has started construction on a new building to house its research laboratory. The building will rank among the country's finest industrial research laboratories and will cost $500,000, including equipment. Dr. Francis C. Frary, who has been in charge of research activities since 1918, will head the organization, with Dr. J. D. Edward and H. E. Bakken as assistants. The staff will number about 150.

The H. L. & H. Co., a new concern organized and incorporated recently at Houston, Tex., with a capital stock of $65,000, has announced plans for the establishing of a plant in Houston during the next few months for the manufacture of pumps designed for the purpose of removing sand from oil wells. G. A. Humanson, 3019 Hamilton St., Houston, is one of the officials of the new company.

The Western Springs Co., with headquarters in Regina, Saskatchewan, has been incorporated under provincial laws. Ira H. Bowman, Regina automobile accessory distributor, is head of the company, and with him is associated J. W. Alexander, who was at one time majority stockholder in the Guelph Spring and Axle Co. The firm plans to manufacture automobile and truck springs.

The Sargent Machine Co., Fort Dodge, Iowa, will increase its production fourfold upon completion of an addition to the plant, now under way. The addition will provide for the manufacture of the new junior drag line and excavator made by the company. The old unit of the plant will be devoted to the manufacture of a small platform-operated model of highway motor truck.

The Syracuse Washing Machine Corporation has acquired a subsidiary company of the Splitdorf Bethlehem Electrical Corporation, manufacturing the Rol-Iron ironing machine. Manufacturing operations are being transferred from Detroit to Syracuse, N. Y. Output has been increased to 350 machines per month, which is between 50 and 100 greater than previously.

Stockholders of the Minneapolis Steel & Machinery Co. have approved the proposed consolidation of that organization with the Minneapolis Threshing Machine Co., and the Moline Implement Co. under a new corporation to be known as the Minneapolis-Moline Implement Co. with headquarters at Minneapolis, Minn.

The Fusion Welding Corporation, a subsidiary of the Chicago Steel & Wire Co., 103rd St. and Torrence Ave., Chicago, has taken over the sale of all welding rod manufactured by the parent company, and will market it in connection with the sale of Fuzon welding equipment.

The Electric Motor & Repair Co. has announced the recent opening of a new branch office at Raleigh, N. C., for the distribution in that section of the Carolina territory of Westinghouse motors, parts and equipment, and the service and repair of motors. R. E. Ward is the head of the company.

Haworth Machine Shop of Rapid City, S. D., and Hogarth & Son, Inc., of Deadwood, have consolidated to establish a machine shop in Rapid City. A site is to be purchased and a machine shop costing approximately $60,000 is to be erected. A foundry is later to be added.

The Model Brass Foundry, 232 East Decatur St., Decatur, Ill., has remodeled its furnace room and added a third oil-burning furnace in a 30-foot extension. A new brick machine shop, 24x40 ft., is to be built.

Hise Bed Springs Corporation, of Rolla, Va., has been recently chartered with an authorized maximum capital of $50,000 to manufacture and sell steel frames and coil bed springs. J. A. Brown, of Rolla, is president.

The Carboloy Co., Inc., of New York, has opened a branch sales office at Bridgeport, Conn., in charge of Harry Hater. This branch comes within the district headed up at Newark, N. J., by W. J. Linder.

J. A. Drake & Sons, Inc., have changed the firm name to the Jadson Motor Valve Co., and have moved to new and larger quarters at 8354 Wilcox Ave., Bell, Calif.

Personals

H. E. Harvey has been promoted from general superintendent to works manager of the Cleveland and Detroit plants of Steel & Tubes, Inc., with supervision of the Brooklyn plant added to his duties. Mr. Harvey will co-ordinate manufacturing activities at all three plants, but will make Cleveland his headquarters. H. J. Kaighin, superintendent of the Detroit plant, has been made superintendent of the Brooklyn plant. Edward Kamper, superintendent of the Cleveland plant, has been transferred to the superintendency of the Detroit plant. C. W. Colvin has been promoted from the position of assistant superintendent and chief engineer to the superintendency of the Cleveland plant. The company has just completed its new $2,000,000 plant in Detroit.

E. M. Wood, formerly superintendent of the Edgewater plant of the National Carbon Co., at Cleveland, has been made manufacturing superintendent of the Raytheon Manufacturing Co., Cambridge, Mass. Both companies are subsidiaries of the Union Carbide and Carbon Corporation. R. L. Lechner has been transferred from the sales department in New York to succeed Mr. Wood as superintendent of the Edgewater plant. J. K. Gressle, formerly assistant superintendent of the Edgewater works, has been transferred to the Radio division, at Factory A, as assistant superintendent. K. S. Grant has been made head of the accounting division of the works manager's office.

Louis G. Randall has been made general factory manager of the Standard Aircraft Corporation, Paterson, N. J. From the position of management engineer with the inspection division of the Air Corps, United States Army, he went in 1917 to the Standard Aero Corporation, New York, as assistant superintendent of factories at Plainfield, N. J., becoming later general manager.

W. W. Phillips has been appointed district sales manager of the Metropolitan New York and Eastern States district for the Columbia Tool Steel Co., Chicago Heights, Ill. Branch office and warehouse space has been taken at 87 Poinier St., Newark, N. J., where a large stock of high-speed, alloy and carbon tool steel is carried.

Russell G. Hyde, who has been in the production and estimating departments of the National Acme Co. for ten years, has been appointed production manager. He succeeds G. W. Sprague, who resigned a few weeks ago to take a position with the Wright Aeronautical Corporation of Paterson, N. J.

W. S. Saunders has been elected president of the American Forging & Socket Co., Pontiac, Mich., succeeding the late C. M. Crofoot. Mr. Saunders has been connected with the company 14 years, and was formerly vice-president and general manager.

Wm. S. Jones, formerly vice-president of the Carpenter Steel Co., has just been made vice-president in charge of sales of the Universal Steel Co. of Bridgeville, Pa., and the Cyclops Steel Co. of Titusville, Pa., with headquarters at 10 East 40th St., New York.

James H. McGraw, chairman of the board of the McGraw-Hill Publishing Co., New York, on June 11 received the degree of Doctor of Commercial Science at the annual commencement of New York University.

Henry M. Laws, general superintendent of the Wilmington (Del.) plant of the Eastern Malleable Iron Co., has been appointed general superintendent of the company's plant at Bridgeport, Conn.

William F. Quinn, formerly with the James & E. H. Wilson Co., of Pittsfield, has been appointed office manager of the Baush Machine Tool Co., Springfield, Mass.

C. A. Portman has been promoted to the position of plant manager of the Oliver Chilled Plow Works, South Bend, Ind. Previously he was general superintendent.

A. M. Foster has been elected chairman of the board of the Foster Bolt & Nut Manufacturing Co., Cleveland, Ohio. He was formerly president. J. F. Donahue, formerly vice-president and general manager, has been made president. The office of secretary and treasurer, held by the late A. L. Empey, will be filled at the annual meeting in August.

F. L. Driver, Jr., president of the Driver-Harris Co., recently sailed for Europe on a business trip. He will visit the company's plants in England, France and Italy.

Obituaries

Henry W. Wendt, president of the Buffalo Forge Co., of Buffalo, died June 12 at his home as a result of an attack of pneumonia. He lacked one week of being 67 years old. He was a member

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of the American Society of Mechanical Engineers and the American Society of Heating and Ventilating Engineers. His connection with Buffalo Forge had existed for fifty years.

Edgar A. Fletcher, who succeeded his father as head of the Athol Pump Co., Athol, Mass., selling the controlling interest two years ago to the Leavitt Machine Co., Orange, Mass., died recently. He was 62 years old.

P. S. Sinclair, vice-president of the Holyoke Heater Co., Holyoke, Mass., died in his home in that city June 6, at the age of 64.

Forthcoming Meetings

American Society for Testing Materials. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

American Society of Mechanical Engineers.—Semi-annual meeting, Salt Lake City, Utah, July 1-4. Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

A SLIGHT recession is noted in steel buying this week. Production keeps at high levels of last month, owing to large volume of unfilled orders. Steel pipe demand is active, particularly in the oil fields. Mechanical tubing continues to move, with demand slackening in slightly less than half of the automotive industry's capacity. Dealers appear certain that current steel prices will continue over into July. Non-ferrous metals remained steady over the week end, with the exception of a decline of ¼c. per lb. (46½c.) in tin at New York warehouses and a drop of 0.2c. per lb. (6.6c.) in slab zinc at East St. Louis.

(All prices as of June 14, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$18.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	21.25
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	15.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.76)	21.76
Virginia No. 2	24.79
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	21.26
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20.26
Basic	20.26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.20	3.35	3.25	3.90*
No. 12	2.25	3.45	3.30	3.95*
No. 14	2.35	3.55	3.35	4.00*
No. 16	2.45	3.65	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.85	3.70	3.80
No. 22	2.80@2.90	4.00	3.85	3.95
No. 24	2.85@2.95	4.05	3.90	4.00
No. 26	2.95@3.05	4.15	4.00	4.10
No. 28	3.10@3.20	4.75	4.15	4.25
Galvanized				
No. 10	2.80@2.90	4.20	4.05	4.05
Nos. 12 to 14	2.90@3.00	4.30	4.15	4.15
No. 16	3.00@3.10	4.40	4.25	4.25
No. 18	3.15@3.25	4.55	4.40	4.40
No. 20	3.30@3.40	4.70	4.60	4.55
No. 22	3.35@3.45	4.75	4.65	4.60
No. 24	3.60@3.70	4.90	4.75	4.75
No. 26	3.75@3.85	5.15	5.00	5.00
No. 28	4.00@4.10	5.40	5.25	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness B.w.g. and Decimal Fractions		Outside Diameter in Inches ⅛	¼	⅜	½	1	1¼	1½
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— $\frac{3}{32}$, 8.35c. per lb; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			46.50
Lead, pigs, E. St. Louis	6.80	New York	8.25
Zinc, slabs, E. St. Louis	6.60	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	11.50	13.00	14.25
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	19.87½	19.87½	19.87½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.50@11.00	11.70	10.11
Solder (½ and ½).....	32.00	32.75	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			61.00
Commercial genuine, intermediate grade.....			45.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.00

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	13.50 @13.75	13.50	13.00 @14.00
Copper, heavy, and wire..	13.50 @13.75	13.00	12.00 @13.00
Copper, light, and bottoms	12.00 @12.25	12.50	11.00 @12.00
Heavy lead.....	5.12½@ 5.62½	6.25	5.00 @ 5.50
Tea lead.....	2.37½@ 2.87½	4.25	4.00 @ 4.50
Brass, heavy, yellow.....	9.00 @ 9.25	8.00	8.00 @ 8.50
Brass, heavy, red.....	.....	12.50	12.00 @12.50
Brass, light.....	7.37½@ 7.50	7.50	8.00 @ 8.50
No. 1 yellow rod turnings.	9.25 @ 9.50	9.00	10.00 @10.50
Zinc.....	3.75 @ 4.00	3.25	3.00 @ 3.25

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.112	.11	114
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.2125	.2125	.17
Solder (½ and ½).....	per lb..	.32	.325	.3275
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.60	3.10
Lard cutting oil.....	per gal.	.55	.55	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	31½%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.50	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.64	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.75@2.85
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, ⅞-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mass., Boston—Shipman Machine Co., 218 Summer St.—Brown & Sharpe or Cincinnati No. 3 milling machine, geared head.

Mass., Jamaica Plain (Boston P. O.)—P. O. Box 25—automobile repair shop equipment including battery charger, check protector and electric drill.

Mass., Roxbury (Boston P. O.)—Schoolhouse Dept., City Hall, Boston—woodworking equipment for Boston Trade School, Parker St. here.

Mich., Lansing—Olds Motor Works—material handling equipment for transferring and loading automobile parts for proposed 3 story, 130 x 420 ft. plant.

O., Akron—Akron Selle Rite Co., 491 South Main St.—four or five punch presses.

Pa., Pittsburgh—M. B. Kelly, Park Bldg.—machinery and equipment for the manufacture of nails including 4 slide wire forming, spring forming, wire binding and wire threading.

Pa., Pittsburgh — Miller Printing Machine Co., Walker and Reedsdale St. N. S.—40 in. open side planer.

Ontario—Ditchburn Boats Ltd., Orillia, H. Ditchburn, Mgr.—machinery and equipment for building custom boats and sea going cruisers for proposed additions to plants at Orillia and Gravenhurst. Estimated total cost $200,000.

Ont., Hamilton — Bd. of Education, R. H. Foster, Secy., City Hall—metal working equipment, etc. for machine and woodworking shops for proposed 3 story, 165 x 385 ft. high school. Estimated cost $1,250,000.

Ont., Niagara Falls — Canadian Ohio Brass Co.—machinery and equipment for the manufacture of brass.

Opportunities for Future Business

Calif., Escondido — Escondido Union High School Dist., is having plans prepared for the construction of a high school including shop building, etc. Estimated cost $150,000. Kistner & Co., Archts.

Calif., Oakland—Boiler, Tank & Pipe Co., 4061 Rollis St., awarded contract for the construction of a 1 story addition to boiler shop at 75th Ave. and Snell St.

Calif., San Francisco—W. Voelker Co., Mission and 3rd Sts., will soon award contract for a 5 story factory on Howard St. Estimated cost $150,000. G. W. Kelham, 315 Montgomery St., Archt.

Conn., Hartford—R. P. Taber, 128 Allyn St., is having plans prepared for a 1 story, 200 x 250 ft. garage and service station on Albany Ave. Estimated cost $175,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt.

Ga., Atlanta—W. T. Candler, Candler Bldg., awarded contract for a 2 and 3 story, 158 x 190 and 60 x 80 ft. garage on West Peachtree St. and Grant Pl. Estimated cost $200,000.

Ill., Bensenville—Wills Motor Co., First Ave. and Main St., Maywood, awarded contract for a 1 story, 60 x 1,600 and 90 x 90 ft. factory here. Estimated cost $1,200,000. Noted June 6.

Ill., Chicago—Edison Electric Appliance Co., 5600 West Taylor St., Cicero, Ill.; awarded a 1 story addition to factory here. Estimated cost $10,300.

Ill., Chicago—Evans Bros., 710 South Tripp Ave., awarded contract 1 story, 50 x 60 ft. machine shop at 4214 Taylor St.

Ill., Chicago — Nordendale Mfg. Co., 1638 North Paulina St., plans the construction of a 2 story, metal stamping factory at Hoyne Ave. and Fulton St.

Ill., Chicago—Pyle National Co., 1338 North Kostner Ave., awarded contract for the construction of a 91 x 110 ft. addition to factory for the manufacture of railroad equipment. Estimated cost $48,000.

Ill., Chicago—O. Rixon, 4450 Carroll Ave., manufacturers of building hardware, awarded contract for a 2 story, 29 x 70 ft. addition to factory. Estimated cost $22,000.

Ill., Chicago—Service Tool Die & Mfg. Co., 2256 West Walnut St., awarded contract for a 2 story, 100 x 110 ft. factory for the manufacture of dies, tools, gauges, jigs, bakelite moulds and special machinery. Maturity September.

Ill., Chicago—Standard Stamping & Perforating Co., 4718 West 5th Ave., manufacturers of perforated metals, sheets, screens, etc. plans the construction of a 1 story, 90 x 143 ft. factory. Estimated cost $20,000.

Ill., Chicago — Thomas Engineering & Mfg. Co., 616 South Michigan Ave., awarded contract for a 2 story 50 x 125 ft. factory for the manufacture of radio parts. Estimated cost $50,000.

Ill., Chicago — Western Screw Co., A. Ziv, Pres., 38 South Dearborn St., is having plans prepared for a 1 and 2 story factory at 47th Pl. and Kedzie Ave. Estimated cost $263,000. A. Epstein, 2000 West Pershing Rd., Archt.

Ill., Kewanee—Kewanee Mfg. Co., R. H. Hayward, Gen. Mgr., will receive bids end of June for a 1 story, 122 x 200 ft. factory for the manufacture of copper steel coal shutes, basement windows, coal yard supplies and other steel products. Estimated cost $50,000. F. B. Chase Inc., 720 North Michigan Ave., Chicago, Archts. Noted May 9.

Ind., Fort Wayne—A. Wayne Co., awarded contract for a 2 story, 45 x 150 ft. garage and service building at Lafayette and Washington Sts. Estimated cost $50,000.

Ia., Sioux City — J. V. Thorndike, awarded contract for a 1 story, 100 x 150 ft. sales and service building at West 7th and Kansas Sts. Estimated cost $125,000.

Md., Baltimore — J. M. Reiser & Sons, 620 Portland St., manufacturers of barrels and kegs, will build a plant at Chesapeake Ave. and 5th St.

Md., Baltimore — C. O. Wurzburger & Son, Annapolis Ave., manufacturers of mill and cabinet work, plans a 40 x 80 ft. addition to plant.

Mass., Brookline—W. Greenwood, 8 Emerson St., is having plans prepared for a 1 story, 125 x 150 ft. repair and service garage at 304-312 Washington St. Private plans.

Mass., Fall River — W. E. Fawcett, 1437 Robeson St., is having plans prepared for a 1 story repair and service garage on North Main St. Estimated cost $40,000. E. M. Corbett, Bedford St., Archt.

Mass., Hyde Park—Edison Electric Illuminating Co., Boylston St., Boston, is receiving bids for a 1 story, 130 x 155 ft. garage and repair shop on Hyde Park Ave. Bigelow, Wadsworth, Hubbard & Smith, 11 Beacon St., Boston, Archts.

Mass., Lynn—Ravin & Gordon, 1 Market St., awarded contract for a 1 and 2 story garage and repair shop. Estimated cost $80,000. Noted Jan. 31.

Mass., Nantucket—Nantucket Co., is having plans prepared for the construction of a 1 story woodworking shop at Old North Wharf. Private plans.

Mass., Springfield—Moore Drop Forging Co., 38 Waters St., plans to rebuild a 2 story plant destroyed by fire. McClintic & Craig, 458 Bridge St., Archts.

Mass., Taunton—North Dighton Stove Co., H. H. Lincoln, Pres., plans to rebuild plant destroyed by fire. Architect not selected.

Minn., Minneapolis — Northland Transportation Co., 515 6th Ave. N., awarded contract for a 100 x 150 ft. garage, etc. Estimated cost $125,000.

N. J., Newark—American Platinum Works, 231 New Jersey Railroad Ave., awarded contract for a 2 story, 40 x 125 ft. addition to factory at Oliver and New Jersey Railroad Ave. Estimated cost $50,000.

N. J., Newark — E. C. Epple, 44 Commerce St., Assoc. Archt., will receive bids about July 1, for a 3 story, 200 x 206 ft. factory at Central Ave. and 16th to 17th Sts. for Packard Motor Car Co., Broadway and 61st St., New York. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt.

N. J., Newark—White Motor Co., East 79th St., Cleveland, O., awarded contract for a 1 and 2 story, 200 x 270 ft. service station, etc. on Mulberry St. here. Estimated cost $150,000.

N. J., Paterson—Watson Flagg Engineering Co., 214 Straight St., plans the construction of a 1 story foundry on 18th Ave. Estimated cost $40,000. Private plans.

N. J., Paterson—Wright Aeronautical Corp., 238 Lewis St., awarded contract for a 1 story addition to factory on Madison Ave. Estimated cost $750,000. Noted June 13.

N. Y., Long Island City—J. Wagner, 147 47th Jasmine Ave., Flushing will build a machine shop at 11th St. and 36th Ave. here. Estimated cost $45,000. F. O'Rouke, 28-28 Hunters Point Ave., Long Island City, Archt. Noted May 30.

N. Y., New York—R. Bernson, 1306 Jerome Ave., plans a 4 story 92 x 100 ft. garage at 408 East 18th St. Estimated cost $80,000. W. Shary, 41 Union Sq., Archt.

N. Y., New York—L. & W. Operating Co., 391 East 149th St., will build a garage at Wooster St. and West Broadway. Estimated cost $80,000. W. Shary, 41 Union Sq., Archt.

N. Y., New York—W. S. & D. L. Reardon Co., 80 Wall St., plans the construction of a 1 story, 70 x 150 ft. garage at 296 South St. Estimated cost $40,000. L. A. Sheinart, 194 Bowery, archt.

O., Cleveland—Bender Body Co., H. Bender, Pres., 6409 Barberton Ave., awarded contract for a 1 story, 135 x 175 ft. addition to factory. Estimated cost $150,000. Noted June 13.

O., Cleveland—Cleveland Chair & Mfg. Co., L. D. Round, Pres., Stop 3 Bedford Line, is receiving bids for a 1 story, 40 x 100 ft. factory and 34 x 60 ft. office. Estimated cost $40,000. H. W. Maurer, 5716 Euclid Ave., Archt.

O., Cleveland — F. Zimmerman Co., West 110th and Berea Rd., manufacturers of picture frames, is receiving bids for a 1 story, 30 x 120 ft. addition to factory. Estimated cost $40,000.

O., Youngstown—Republic Iron & Steel Co., 17 Battery Pl., New York, N. Y., awarded contract for addition to tube mill here.

Pa., Clairton — Carnegie Steel Co., Carnegie Bldg., Pittsburgh, will build a 1 story, 47 x 114 ft. plant here. Estimated cost $50,000. Private plans.

Pa., Monongahela—Cosocton Iron Works, will build a 1 story, 160 x 480 ft. addition to plant. Estimated cost $150,000.

Pa., New Castle—Lawrence Motor Co., will soon award contract for a 4 story, 150 x 160 ft. garage on Mercer St. Estimated cost $150,000. W. G. Eckles Co., Lawrence Savings & Trust Bldg., Archt.

Pa., New Kensington — Aluminum Co. of America, Oliver Bldg., Pittsburgh, will build a 1 and 3 story laboratory here. Estimated cost $250,000. P. Hogner, c/o owner, Archt.

Pa., Philadelphia—Twenty-second St. Realty Co., c/o E. A. Stopper, 10 South 18th St., Archt., will soon award contract for a 2 story, 64 x 133 x 64 x 130 ft. sales and service garage at 248-54 North 22nd St. Estimated cost $150,000.

Pa., Pittsburgh—Keystone Box Co., 28th and Smallman Sts., is having plans prepared for a 3 story, 50 x 100 ft. addition to box factory. Estimated cost $50,000. P. Dietz, Lyceum Bldg., Engr.

Tex., Austin — Bd. of Regents, c/o J. W. Calhoun, Comptroller, awarded contract for the construction of a 1 story engineering shop building. Estimated cost $150,000.

Ont., Mount Dennis—Ferranti Electric Ltd., 26 Noble St., Toronto, will soon receive bids for a 1 and 2 story, 110 x 400 ft. factory here. Estimated cost $100,000. Ewart, Armer & Byam, 36 Toronto St., Archts. Noted Apr. 11.

Ont., Windsor—Champion Spark Plug Co. awarded contract for addition to factory. Estimated cost $150,000.

Que., St. Gregoire—P. N. Mathiau, plans the construction of a saw mill. Estimated cost $30,000.

Que., Montreal—Canadian Air & Equipment Co. awarded contract for a 2 story, 42 x 71 ft. plant on Paul Kruger St. Estimated cost $20,000.

Saskatchewan—John Deere Plow Co., 504 3rd Ave., Moline, Ill., is having plans prepared for the construction of a warehouse at Swift Current, also addition to plant at Saskatoon and addition to plant at Weylurn here. Total estimated cost $110,000.